JULY, 1933.

GENERAL PHYSICS.

ADSORPTION.

2663. Adsorption of Hydrogen on Pyrex and Quartz. A. T. Williamson. *Am. Chem. Soc., J.* 55. *pp.* 1437–1441, *April,* 1933.—The rate of adsorption of hydrogen by quartz and pyrex has been measured between 400 and 550° C. at a pressure of 760 mm. Equilibrium values obtained after several hours' exposure to pyrex conform to Langmuir's adsorption isotherm and not to Henry's law, and it is therefore believed that the process is one of true adsorption and not one of solution. The results do not support Alyea's theory of the upper explosion limit in the hydrogen-oxygen reaction. F. J. W.

2664. Adsorption of Caesium at Layers of Calcium Fluoride. J. H. de Boer and C. J. Dippel. *Zeits. f. phys. Chem.* 21. *Abt.B.* 4. *pp.* 278–291, *May,* 1933.—Quantitative investigation of the adsorption of caesium vapour at layers of vacuum-sublimed calcium fluoride gives results indicating polyatomic adsorption. T. H. P.

2665. Adsorption and Solution Volume. Part II. Dependence of the Ionic State on Dilution. E. Ivanova and A. Rabinerson. *Kolloid Zeits.* 63. *pp.* 165–169, *May,* 1933.—This paper continues Part I [see Abstract 358 (1930)] and from special adsorption data with various kaolins records that for an initial content of 100 milli-equivalents, NaCl, 10 Na_2CO_3 and 1 Na_2CO_3, the exchanged amount of sodium falls with the dilution. In the system 1·17gm. Na-kaolin + 2 milli-equivalents $BaCl_2$, no dilution effect was observed. Other factors which increase the adsorption are studied with respect to the dilution-effect. H. H. Ho.

2666. Gas-Adsorption on Electrically-Conducting Films During their Condensation from Molecular Rays. M. C. Johnson and T. V. Starkey. *Roy. Soc., Proc.* 140. *pp.* 126–140, *April* 1, 1933.—Experiments are described in which a beam of molecular rays condenses into an electrically-conducting film on a target cooled with liquid air. The beam consists of a constant stream of Hg vapour, with controlled additions of H_2, O_2, A, CO_2 and various ionised gases in turn. Analysis of curves showing the rate of growth of conductivity reveals certain repeatable effects which persist after cessation of gas-admission. The first Hg atoms are trapped and prevented from free lateral migration in the irregularities of a vapour-covered target, and constitute the stage of growth of the deposit characterised by slowest rise of conductivity, least penetrability to gas subsequently applied, and a rate of evaporation measurable in days instead of minutes. Hg atoms arriving later build up an outer structure loose enough for gases to diffuse in and out of it at velocities high compared with penetration into an ordinary lattice or crystal aggregate. The action of H_2, O_2 and A appears to result in the formation of saturated unimolecular layers on the enormous accessible area of loose metallic deposit ; Hg atoms striking these layers adsorb so weakly that evaporation of a large proportion of the deposit can occur immediately on rise in temperature of a few degrees at − 110° C. With CO_2 and ionised O_2 there is further evidence that non-conducting barriers are formed in the interstices, causing fall of conductivity, and not merely facilitating re-evaporation of mercury. These results agree with what is known from microscopical data concerning the growth of loosely aggregated structures from mercury vapour in presence of gas, and confirm the " gap " theory of the mechanism of thin film resistance. T. H. P.

2667. Adsorption in Solutions and Physical Properties of the Solvent. Part II. E. Heymann and E. Boye. *Kolloid Zeits.* 63. *pp.* 154–165, *May*, 1933.—This paper continues Part I [see Abstract 1011 (1931)] and deals with the complete adsorption isotherms for a large number of binary liquid mixtures and charcoal, using an interferometric method of analysis. Two curve types are obtained according to the ratio of the amounts of adsorption, *viz.*, (1) when one component greatly exceeds the other, the curve then passes through a maximum and generally becomes asymptotic to the abscissa; and (2) when both components are similarly adsorbed, the curve then passes through a maximum to a minimum below the concentration axis, and finally reaches zero. The general form of the curves is discussed in relation to the surface tension curves. In systems of homologous alcohols with carbon tetrachloride, a reversal of the Traube rule occurs. In mixtures of an aromatic with an aliphatic compound, the former is more strongly adsorbed by the charcoal than the latter, and this phenomena is discussed. Data with respect to the adsorption of a third substance in small concentration from the liquid mixtures are correlated with the dielectric properties of the mixtures. H. H. Ho.

2668. Theory of the Monomolecular Adsorption Layer. N. Fuchs. *Zeits. f. phys. Chem.* 21. *Abt.B.* 3. *pp.* 235–241, *May*, 1933.—Based on the Langmuir adsorption theory, the case of unidimensional (linear) adsorption is statistically derived and discussed from considerations of the active forces between the molecules of a monomolecular adsorption layer. H. H. Ho.

2669. Surface Films of Unsaturated Compounds. A. H. Hughes. *Chem. Soc., J. pp.* 338–344, *April*, 1933.—Unsaturated long-chain fatty acids have been examined in unimolecular films by the surface potential and surface pressure methods. The contribution of the double bond to the vertical component of the molecular dipole moment (at water/air interface) is small in comparison with that of the carboxyl end group. It is larger when in $\alpha\beta$ position than when further along the chain. The triple bond has a larger effect. Results due to conjugation of double bonds are also described. A. S. C. L.

2670. Structure of Surface Films. Part XVII. γ-Hydroxystearic Acid and its Lactone. N. K. Adam. *Roy. Soc., Proc.* 140. *pp.* 223–226, *April* 1, 1933.—Area/force curves show that γ-hydroxystearic acid on $N/50$–HCl forms at ordinary temperature a liquid expanded film with area at low compression of about 52Å^2, but below 4° a condensed film; on an alkaline solution the film is gaseous. The lactone forms a condensed film, area for zero compression 29Å^2 on dilute acid or alkali or on water; on N–NaOH it is rapidly hydrolysed. [See following Abstract.] C. A. S.

2671. Structure of Monomolecular Films. Part I. R. J. Fosbinder and Anna E. Lessig. *Frank. Inst., J.* 215. *pp.* 425–433, *April*, 1933.—ΔV/area curves of myristic and palmitic acids, the acids being spread by means of solutions in hexane, indicate transition points and give values of ΔV, μ, and $\bar{\mu}$ in close agreement with those obtained by Schulman and Rideal [see Abstract 2072 (1931)]. Stearolactone on a citrate buffer of pH 6·4 at 16° gives a liquid condensed film, with area for zero compression 31Å^2, μ $4 \cdot 62 \times 10^{-19}$, $\bar{\mu}$ $4 \cdot 55 \times 10^{-19}$, and $\Delta V \mu + 15$ millivolts. The high value of μ is ascribed to the ⋮C–O–C⋮ linkage. [See preceding Abstract, also following Abstract.] C. A. S.

2672. Structure of Monomolecular Films. Part II. Surface Films of Proteins. R. J. Fosbinder and Anna E. Lessig. *Frank. Inst., J.* 215. *pp.* 579–591, *May*, 1933.—Force–1/A (A area) curves and changes in surface potential, ΔV, have been determined for egg and serum albumens, edestin, pepsin, casein, and tripsin on substrates of various pH. The three first named give linear compression curves for concentrations of $1 \cdot 43$–$2 \cdot 40 \times 10^{-7}$ gm./cm.^{2}, and ΔV/concentration curves indicating homogeneous films for $1 \cdot 31$–$1 \cdot 93 \times 10^{-7}$ gm./cm.^{2}. The area per molecule for zero compression, though dependent to some extent on the pH of the substrate—possibly due to hydration—varies almost directly with the mol. wt. of the protein, being for edestin 28,000, serum albumen 7300–7500, and egg albumen 2600–3800 Å^2. An isodisperse protein of partial mass $> 34{,}500$ does not spread spontaneously if the pH of the substrate is within that of its pH stability range. The protein micelles in a close packed film probably have the α-keratin structure. C. A. S.

See also Abstract 2936.

ATOMIC AND MOLECULAR STRUCTURE.

2673. Constitution of Metallic Sodium. E. Wigner and F. Seitz. *Phys. Rev.* 43. *pp.* 804–810, *May* 15, 1933.—Previous developments in the theory of metals may be divided clearly into two parts: that based principally upon the hypothesis of free electrons and dealing with conductivity properties, and that based upon calculations of valence forces and dealing with the chemical properties. In the present article an intermediate point of view is adopted and the free-electron picture is employed in an investigation of chemical properties of metallic sodium. The assumption is made that in the metal the K and L shells of an atom are not altered from their form in the free atom. The properties of the wave functions of the electrons are discussed qualitatively, first of all, and it is concluded that the binding energy will be positive even when the Pauli principle is taken account of. This is followed by a quantitative investigation of the energy to be associated with the lowest state. First of all it is shown to what extent the present picture takes account of the interactions of electrons with both parallel and antiparallel spins, and to what extent remaining effects may be neglected. Next a Schrödinger equation is solved in order to determine the lowest energy level for various values of the lattice constant. To this a correction is made to account for the Pauli principle and from the result the lattice constant, binding energy and compressibility are calculated with favourable results. AUTHORS.

2674. Atomic Weight of Lead from Bedford Cyrtolite. G. P. Baxter and C. M. Alter. *Am. Chem. Soc., J.* 55. *pp.* 1445–1448, *April*, 1933.—In a specimen of cyrtolite the lead-uranium ratio was 0·0513 (Pb 0·374, U 7·29). The lead was separated and purified exhaustively and the atomic weight determined nephelometrically by comparison of the lead chloride with silver. The average value obtained was 205·92 ± 0·02, indicating that the cyrtolite lead is derived from uranium, and is essentially free from common lead. N. M. B.

2675. Atomic Masses and Structure of Atomic Nuclei. K. T. Bainbridge. *Frank. Inst., J.* 215. *pp.* 509–534, *May*, 1933.—This lecture traces the development of modern theories of nuclear structure from Aston's pioneer work on isotopes. The theory and practice of the determination of atomic masses with the mass-spectrograph are treated in detail and the most important recent results obtained by Aston and by the author (including the measurement of the mass of H^2) are described. The chief results of artificial disintegration and Wilson cloud-chamber experiments, and the recent discoveries of the neutron and positive electron (positron) are also discussed. The problem of nuclear structure is approached from the standpoint of the mass-energy considerations arising from the accurate determinations which have been made of the masses of the probable constituent particles of the nucleus. J. E. K.

2676. Separation of Isotopes by G. Hertz's Method. H. Harmsen. *Zeits. f. Physik*, 82. 9–10. *pp.* 589–609, *May* 23, 1933.—An apparatus for separating isotopes by G. Hertz's method [see Abstract 420 (1933)] is described, which for an equal number of separable components gives, in the case of the neon isotopes a five-fold greater degree of separation than the original apparatus. By a single application of the process a change in the concentration ratio by a factor of about 40 is achieved in the case of the neon isotopes 20 and 22. By successive application of the process a practically complete separation of neon isotopes is obtained, each fraction containing not more than 1 % of the other isotope. J. E. K.

2677. Quantum Mechanics of Chemical Valency. H. Hellmann. *Zeits. f. Physik*, 82. 3–4. *pp.* 192–223, *April* 29, 1933.—The programme of a semi-empirical theory of homopolar valency is laid out, which deduces the reciprocal action of atom groups as a function of their configuration with respect to atomic pairs. The range of such a theory is discussed on the basis of a second approximation of the disturbance calculus. The participation of only one state of every atom in the union is described by means of two reciprocal functions of the nuclear distance, *viz.*, a diagonal and an exchange function. Examples in support of the theory are given from nitrogen-hydrogen compounds, and applications are made to various hydrocarbons in which more than two reciprocal functions are required. The valency theory of organic chemistry is discussed from the standpoint of Slater's approximation formula [see Abstract 333 (1932)]. H. H. Ho.

2678. Binding and Activation Energies of Organic Molecules. W. Heitler and A. A. Schuchowitzki. *Phys. Zeits. d. Sowjetunion*, 3. 3. *pp.* 241–261, 1933.—This entirely mathematical paper first discusses current theory with applications to ethane and cyanogen, and then develops a simplified theory which is related to the above as classical mechanics is to the quantum theory. The final section is devoted to the activity of the binding energy in organic chemistry. H. H. Ho.

2679. Electronic Structure of Ethylenic Carbon. G. Allard. *Comptes Rendus*, 196. *pp.* 1500–1502, *May* 15, 1933.—An ethylenic carbon atom is one attached by a double bond to another carbon atom. The wave function must differ from that for a carbon atom attached to four separate radicals. Suggests that the valencies are directed valencies, three in a common plane at angles of 120° to each other, and one perpendicular to their plane. J. H. A.

2680. Atomic Weight of Iodine. Guichard. *Comptes Rendus*, 196. *pp.* 1024–1026, *April* 3, 1933.—Polemical; on use of iodine pentoxide for the determination of the atomic weight. A. S. C. L.

See also Abstracts 2726, 2797, 2798, 2799, 2800, 2802, 2891, 2962, 3029, 3148, 3210.

COLLOIDS.

2681. Aerosols, Especially of Ferric Oxide. G. Jander and A. Winkel. *Kolloid Zeits.* 63. *pp.* 5–12, *April*, 1933.—The general methods of investigating aerosols and certain properties of condensation-aerosols are considered. An examination is made of the behaviour of colloidally distributed ferric oxide dust, obtained by the action of light on a mixture of a small amount of iron pentacarbonyl vapour with a large amount of air. The points especially considered are the dependency of the mass of the particles on the concentration and gas-pressure of the aerosol system, and the electric behaviour of aerosols, which become charged either spontaneously or as the result of some physical influence. T. H. P.

2682. Electrical Properties of Colloids. Part II. Behaviour of Colloids as Electrolytes. I. N. Mukherjee. *Kolloid Zeits.* 63. *pp.* 36–47, *April*, 1933.—The activities of the hydrogen and chlorine ions, the cataphoretic velocity of the colloidal particles, and the specific conductivities of a number of aluminium hydroxide sols have been measured. The results, which are considered in relation to the analogies between colloidal and ordinary electrolytes, show that characteristic differences exist between these two classes of electrolytes and that the activity and conductivity measurements are closely related to one another. Neither the cataphoretic velocity nor the equivalent conductivity increases regularly with the dilution, as should be the case according to the chemical theory. Calculations from the data given by Pauli and Valkó (*Elektrochemie der Kolloide, Berlin*, 1929) show that the equivalent conductivity diminishes as the dilution changes from 32 to 256, and that the equivalent conductivity is too high to be explained by the activity results. Possibly not the whole of the chlorine is present in the ionised state, although the activity coefficient, calculated as for electrolytes, is about unity. Similar discrepancies are observed with ferric oxide and silica sols. Three types of relationship between conductivity and activity are noted: the conductivity may be either too high or too low to be brought into accord with the activities and cataphoretic velocities, or conductivity and activity may agree. [For Part I see Abstract 2119 (1933).] T. H. P.

2683. Kohlrausch-Weber Theory of the Migrating Boundary. W. Hacker. *Kolloid Zeits.* 63. *pp.* 47–49, *April*, 1933.—With reference to Mukherjee's objection to the Kohlrausch-Weber theory of the migrating boundary [see preceding Abstract] it is shown, for a boundary between two dilute solutions of two binary electrolytes, that the migration of the boundary is not influenced by the ions common to the two electrolytes moving in the opposite direction, if the conditions of the Kohlrausch-Weber theory are fulfilled. T. H. P.

2684. Dependence of Electrokinetic Potential on Current Strength. N. Schönfeldt. *Wiss. Veröff. a. d. Siemens-Konzern*, 12. 1. *pp.* 39–43, 1933.—Previous work of the author had shown the dependence of diaphragm discharge upon current strength by means of electroendosmosis measurements. A number of electroosmotic measurements on inorganic and organic diaphragms were carried out, in which the variations of the electrokinetic potential ζ with changes of current strength I were followed. The course of the ζ–I–curve was qualitatively accounted for by the assumption of a " flow constancy " (*Fliessfestigkeit*) in the boundary layer in combination with the effect of the changes of concentration in the double layer. F. J. B.

2685. Combination of Silk and Wool with Positive and Negative Ions. M. Harris. *Bureau of Standards, J. of Research,* 10. *pp.* 475–479, *April,* 1933.—Wool, with an isoelectric point at pH 3·4, combines with negative ferrocyanide ion in solutions ranging in pH up to about 5·0 and with positive nickel ion in solutions ranging in pH down to about 2·0. Similarly silk, with an isoelectric point of pH 2·5, combines with ferrocyanide ion up to about pH 4·0 and with nickel ion down to about pH 1·8. Evidently these amphoteric proteins combine with both positive and negative ions over a certain range on both sides of the isoelectric point. The extent of this " isoelectric region " depends upon the ions employed as well as upon the protein. The limiting values obtained for the pH at which ions combine with a protein do not necessarily represent the isoelectric point of the protein. AUTHOR.

2686. Effect of Radiation from Radioactive Substances on Flocculation of Colloids. A. Boutaric and Madeleine Roy. *Comptes Rendus,* 196. *pp.* 1020–1022, *April* 3, 1933.—The rate of flocculation of a sol containing positive granules, *e.g.*, of ferric hydroxide or of mastic and aluminium chloride, is greatly increased by exposure to the radioactivity of radon contained in a thin glass bulb ; that of a sol with negative granules, *e.g.*, of arsenious sulphide or mastic alone, is unaffected. The effect is due to the primary β-rays. If the radon is confined in a platinum bulb it is without effect. C. A. S.

2687. Action of Ultra-Violet Radiation on Aqueous Solutions of Gelatin. P. Ponthus. *Comptes Rendus,* 196. *pp.* 1248–1250, *April* 24, 1933.—Previous workers have shown that albumin solutions and various protein complexes exhibit physico-chemical changes under the action of ultra-violet light. As a simplification aqueous solutions of gelatin are used and after irradiation with ultra-violet light a number of physical constants are determined. No coagulation was observed. In a typical example given a 5 % solution was irradiated for 60 min. and the refractive index was unchanged ; the electrical conductivity increased from $81 \cdot 3 \times 10^6$ to $94 \cdot 7 \times 10^6$; the optical density decreased from 0·07 to 0·02 ; the relative viscosity decreased from 1·81 to 1·21 ; and the ratio $\omega = \left(\frac{\eta}{\eta_0} - 1\right) \cdot \frac{1}{\delta}$ remained almost constant. Several possible explanations of the changes are suggested. J. E. R.

2688. Swelling of Plane Gelatin Plates. Interferometric Investigations. Part IV. P. Kornmann. *Kolloid Zeits.* 63. *pp.* 1–5, *April,* 1933.—An interferometric method is used to measure the velocity with which the dimensions of a swelling disc of gelatin change. During the rising of the disc a transitory diminution in thickness occurs. The velocity of expansion of the surface suddenly rises at the same time, but falls rapidly again soon after. This phenomenon is due to the fact that the increase in surface of a swelling gelatin disc is checked while its middle layer is not completely swollen. The result of this is swelling of the gelatin over a limited surface, with consequent formation of stresses in the elastic gel. The sudden expansion of surface after this position is passed causes the temporary fall in thickness. Up to the time when thinning commences, the time of swelling t is given by the empirical equation $t = \mu^2/c$, where μ is the thickness of the original material and c a constant depending on the conditions, such as temperature. T. H. P.

2689. Rhythmic Precipitates. Part II. T. Isemura. *Chem. Soc. Japan, Bull,* 8. *pp.* 108–112, *March,* 1933.—The spacing of bands of silver chromate in gelatin is reduced by illumination. It is suggested that the action of light is to reduce the solubility of the gelatin and, therefore, its protective action upon silver chromate. Ultra-violet radiation retards formation of rings and also reduces their spacing. Copper chromate rings in silica gel do not show these effects. [For Part I see Abstract 1297 (1933).] A. S. C. L.

2690. Radiate Precipitation of Strontium Carbonate. Suzanne Veil. *Comptes Rendus,* 196. *pp.* 1491–1492, *May* 15, 1933.—The Liesegang rings formed when a drop of solution of $SrCl_2$ is placed on gelatin impregnated with solution of K_2CO_3 are similarly figured and described. Each ring consists of a series of separate spots, those of the inner rings being connected by radiate lines. [See Abstract 2476 (1931).] C. A. S.

2691. X-Ray Fibre-Diagrams of Cellulose. K. Hess and C. Trogus. *Zeits. f. phys. Chem.* 21. *Abt.B.* 4. *pp.* 349–352, *May,* 1933.—The authors refuse to accept the observations made by W. Schramek in a recent paper on the correctness of deductions made from X-ray fibre-diagrams of cellulose and its derivatives [see Abstract 2124 (1933)], which are characterised as unjustified. The new modification of cellulose described by Schramek is stated to have been already described by the authors in 1932. J. T.

2692. X-Ray Study of Variations in the Structure of Wood Fibre Walls. C. W. Stillwell. *Physics,* 4. *pp.* 167–171, *May,* 1933.—Characteristic X-ray diffraction patterns produced by transverse, radial and tangential sections of wood fibres have been discussed. There are two fundamental types of orientation of the micelles or fibrils in wood fibres: A, parallel to the fibre axis; B, parallel to each other, but on a spiral at a definite slope to the fibre axis. The deviation from either type may be qualitatively estimated from the diffraction pattern. For type B, the slope of the spiral may be measured with considerable accuracy. When large angles of slope of the micelles are indicated most wood fibres differ fundamentally from cotton. In wood fibres the average slope is at a definite angle to the fibre axis; the deviation is from type B. In cotton fibres the average slope approaches 0°; the deviation is from type A. AUTHOR.

2693. Pore Distribution and Filter Action of Ultra-Filters and Animal Membranes. M. Pisa. *Kolloid Zeits.* 63. *pp.* 139–148, *May,* 1933.—The method of Erbe [see Abstract 4654 (1932)] is used to determine the proportion of pores of different sizes in cellulose and collodion ultra-filters and in the amnion and chorion membranes of sheep embryos, and to investigate their filter action for hæmoglobin. Different portions of the same cellulose filter (" Cellafilter ") or of the same amnion membrane may vary considerably in their pore distribution. All the grades of " Cellafilter " are permeable to hæmoglobin, but some blocking of the pores is observed. The permeability of collodion filters varies markedly with their mode of preparation, the results indicating that the maximum pore diameter which stops hæmoglobin is less than 58 $\mu\mu$. The embryo membranes are found to be completely permeable to hæmoglobin and their pore sizes to be free from ageing effects. In the case of collodion filters it is shown that bacteriophages can pass through pores of diameter about 240–260$\mu\mu$. L. A. W.

See also Abstracts 2665, 2667, 2826, 2833.

CRYSTAL STRUCTURE AND PROPERTIES.

2694. Lattice Energies of the Silver and Thallium Halides. J. E. Mayer. *J. Chem. Phys.* 1. *pp.* 327–334, *May*, 1933.—The lattice energies and lattice constants of the silver and thallium halides are calculated assuming ionic crystals with a van der Waals potential. The latter term, which is large, accounts for the low solubilities (high lattice energies) of the salts. The calculations appear to be quantitatively satisfactory for the thallium halides, TlCl, TlBr and TlI, and for the three silver halides, AgF, AgCl and AgBr. Definite evidence is found for assuming the existence of a homopolar potential in AgI of about 10 % of the total lattice energy. One reason for believing this, is the stability of the zincblende instead of the rock-salt lattice, which latter should be stable were the compound purely ionic. There is presumably some homopolar binding in AgBr but it cannot be large. The thallium salts probably are entirely ionic. The theoretically calculated and experimental (chemical) lattice energies are, respectively, in k.cal., AgF, 219, 217·7; AgCl, 203, 205·7; AgBr, 197, 201·8; AgI, 190, 199·2; TlCl, 167, 170·1; TlBr, 164, 165·6; TlI, 159, 160·8. AUTHOR.

2695. Elongation of Tin Crystals. J. Obinata and E. Schmid. *Zeits. f. Physik*, 82. 3–4. *pp.* 224–234, *April* 29, 1933.—The authors investigate the transformation of tin crystals and show that a simple relationship does not exist between slip and density. There is also no indication of a transition point at high temperatures. H. H. Ho.

2696. Crystalline State of Thin Sputtered Films of Platinum. G. P. Thomson, N. Stuart and C. A. Murison. *Phys. Soc., Proc.* 45. *pp.* 381–387; *Disc.*, 387–388, *May* 1, 1933.—Films of platinum sputtered in various gases have been examined by the method of electron-diffraction. They often show patterns which indicate that the small crystals are oriented with one face parallel to the surface of the specimen, the crystals being otherwise at random. The width of the rings formed by diffraction shows that in many cases the crystals are very small, of the order of 5×10^{-7}cm. Some films of platinum dioxide showed crystals of the order 2×10^{-7} cm. AUTHORS.

2697. Crystal Structure and Lattice Constants of α-(β)-Tungsten. M. C. Neuburger. *Zeits. f. Krist.* 85. *pp.* 232–238, *April*, 1933.—A cubic structure is found for this new modification with $a = 5{\cdot}038 \pm 0{\cdot}003$ Å at 20° C. The atomic positions are :—

$$2\ \mathrm{W} \left|\begin{array}{ccc} 0 & 0 & 0 \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{array}\right|, \qquad 6\ \mathrm{W} \left|\begin{array}{ccc} \frac{1}{2} & 0 & \frac{1}{4} \\ \frac{1}{4} & \frac{1}{2} & 0 \\ 0 & \frac{1}{4} & \frac{1}{2} \\ \frac{1}{2} & 0 & \frac{3}{4} \\ \frac{3}{4} & \frac{1}{2} & 0 \\ 0 & \frac{3}{4} & \frac{1}{2} \end{array}\right|$$

F. I. G. R.

2698. Precision Measurement of the Lattice Constants of Beryllium. M. C. Neuburger. *Zeits. f. Krist.* 85. *pp.* 325–328, *April,* 1933.—Very pure Be containing traces only of Fe, Ba and C was used. The data obtained from a powder photograph, using Cu-K radiation, gives the values $a = 2\cdot2679 \pm 0\cdot0002$ Å, $c = 3\cdot5942 \pm 0\cdot0003$ Å and $\frac{c}{a} = 1\cdot5848$. The shortest inter-atomic distance is $2\cdot2236$ Å and the density calculated from the above values is $1\cdot857$ at a temperature of 20° C. A comparison between the author's previous measurement [see Abstract 4061 (1932)] and the present, shows that Regler's calibration method and Lihl's correction formula yield accurately the same values. W. E. P.

2699. Type of Binding and Lattice Structure of Binary Magnesium Compounds. E. Zintl and E. Husemann. *Zeits. f. phys. Chem.* 21. *Abt.B.* 1–2. *pp.* 138–155, *April,* 1933.—The authors discuss the connection between the structure of binary compounds containing elements which form negative atom ions and the type of binding; the boundary in the Periodic System within which elements forming negative atom ions occur; and the metallic conductivity of non-metallic structures. Particular reference is made to binary Mg compounds, and the results of the X-ray examination of Mg_3P_2, Mg_3As_2, Mg_3Sb_2, Mg_3Bi_2, are given in detail. The authors conclude that Mg_3P_2 and Mg_3As_2 are "anti-isomorphic" with the C-sesquioxides Sc_2O_3–Sm_2O_3 and the compounds Mg_3Sb_2, Mg_3Bi_2 with the A-sesquioxides Sm_2O_3–La_2O_3. W. E. P.

2700. Crystal Structure of Uranium. T. A. Wilson. *Physics,* 4. *pp.* 148–152, *April,* 1933.—A method capable of solving X-ray powder photographs derived from crystal structures of low symmetry is described. By the use of this method, the crystal structure of uranium has been obtained. Uranium crystallises according to space group C_{2h}^3 of the monoclinic system, with 2 atoms in each crystallographic cell. The dimensions of the cell are: $a = 2\cdot829$ Å, $b = 4\cdot887$ Å, $c = 3\cdot308$ Å. Axial ratios are: $0\cdot5791 : 1 : 0\cdot6771$. The X-ray density of uranium is $19\cdot05$. The uranium atoms appear to be prolate spheroids with $3\cdot425$ Å as the major axis and $2\cdot826$ Å as the minor axis. AUTHOR.

2701. X-Ray Analysis of Iron-Tin Alloys. W. F. Ehret and A. F. Westgren. *Am. Chem. Soc., J.* 55. *pp.* 1339–1351, *April,* 1933.—A number of alloys in the iron-tin system were examined by means of the powder method of crystal analysis. It is shown that iron and the other phases are insoluble in tin. Tin is shown to be soluble in iron to the extent of $9\cdot8$ % at 680° C. and $18\cdot8$ % at 900° C. The discrepancies between the results of X-ray analysis and the thermal diagram for the system determined by Edwards and Preece is indicated and discussed. F. J. B.

2702. Mean Atomic Volume and Composition in Copper-Zinc Alloys. E. A. Owen and L. Pickup. *Roy. Soc., Proc.* 140. *pp.* 179–191, *April* 1, 1933.—Alloys of different compositions annealed at the same temperature (500° C. for those with more than 30 % copper and 380° C. for those with less copper) are investigated by the X-ray precision method previously described [see Abstract 2137 (1933)]. In mixed phase regions the mean atomic volume of both phases present remains constant, but the constant value for one phase depends upon the other phase with it. In all pure phases there is a nearly linear increase of mean atomic volume with increasing atomic per cent of zinc. The rate of this increase is practically the same for the α-, β- and γ-phases, but is greater for the ϵ-phase and greater still for the η-phase. This is explained as due to differences in the packing of the Zn-atom, assumed " non-spherical." No relation is found between the distance of closest approach of atoms from phase to phase. In the ϵ- and η-phases, which have a close-packed hexagonal structure, both the base side a and the height/base ratio c of the hexagonal unit vary linearly with composition. With decreasing copper content a increases and c decreases in the ϵ-phase, whereas a decreases and c increases in the η-phase. In mixed regions both a and c remain constant. The positions of the phase boundaries at the annealing temperature are deduced from these results.

L. A. W.

2703. Mean Atomic Volume and Temperature in Copper-Zinc Alloys, with Observations on the β-Transformation. E. A. Owen and L. Pickup. *Roy. Soc., Proc.* 140. *pp.* 191–204, *April* 1, 1933.—Variations of mean atomic volume with temperature between 350° C. and 800° C. are investigated by X-ray precision analysis [see Abstract 2137 (1933)]. The α-, β- and γ-phases are studied, both in pure and in mixed regions. It is found that in each of the pure phases the mean atomic volume is independent of temperature. In mixed regions the mean atomic volume of both phases changes with temperature. In the $(\beta + \gamma)$ region both the phases show a minimum value at about 500° C. In the $(\alpha + \beta)$ region the α-phase shows a maximum at about the same temperature. Alloys of different compositions give identical mean atomic volume-temperature curves for the same phase within the same mixed region. Of the possible explanations for the observed relationships that based upon change of solubility is considered most satisfactory. The β-transformation occurring at about 470° C. is discussed in the light of the experimental results obtained. [See preceding Abstract.] L. A. W.

2704. Mean Atomic Volume and Composition in Silver-Zinc Alloys. E. A. Owen and L. Pickup. *Roy. Soc., Proc.* 140. *pp.* 344–358, *May* 3, 1933. Alloys representing the whole range of composition are investigated by means of the X-ray precision camera previously described [see Abstract 2137 (1933)], the annealing temperature throughout being 380° C. Owing to lattice distortion alloys in the α-region give no X-ray reflection lines when prepared in the usual way, and it is therefore found necessary to prepare them by inter-diffusion at about 450° C. On account of the rapid transformation of the β-phase into $(\alpha + \gamma)$ at 264° C. no reflection lines of the β-phase are obtained by quenching from above this temperature. At constant annealing temperature the mean atomic volume in the pure phase regions is found to change nearly linearly with composition : with increasing zinc content there is a decrease in the α-, γ- and δ-regions, but an increase in the ϵ-region (stable above 300° C.). The mean atomic volume of both phases present in mixed regions is found to be independent of composition. Phase boundaries are determined approximately from the results obtained. A preliminary study of the hexagonal lattice units of the δ-, ϵ- and η-phases indicates analogy to the hexagonal lattices of the copper-zinc system. [See two preceding Abstracts.]

L. A. W.

2705. Chemical and Crystallographic Investigations on Ammonium, Potassium, Rubidium, Caesium and Thallium Cobaltinitrites. A. Ferrari and C. Colla. *Accad. Lincei, Atti,* 17. *pp.* 390–398, *March* 5, 1933.—These salts form anhydrous crystals of the monometric system. The unit cell contains four molecules and the values of a are respectively: 10·81 ± 0·02, 10·44 ± 0·02, 10·73 ± 0·01, 11·15 ± 0·01, and 10·72 ± 0·02 Å, in the order given in the title; the corresponding densities are 2·00, 2·64, 3·18, 3·51 and 5·10. Lead cobaltinitrite is anhydrous and its unit cell is somewhat similar to that of the potassium salt; the isomorphism between the two is indicated by $K_6[Co(NO_2)_6]_2$ — $Pb_3[Co(NO_2)_6]_2$, so that, in the lattice of the lead salt, one-half of the positions occupied by the kations in the lattice of the potassium salt are vacant. T. H. P.

2706. Thermal Analysis of the Anhydrous Systems, $CoCl_2$–$PbCl_2$ and $FeCl_2$–$PbCl_2$. A. Ferrari and C. Colla. *Accad. Lincei, Atti,* 17. *pp.* 473–475, *March* 19, 1933.—The systems $CoCl_2$–$PbCl_2$ and $FeCl_2$–$PbCl_2$ form eutectics, containing respectively 76·5 and 71·5 % of $PbCl_2$, at 424° and 421°. The curves representing the primary crystallisation approximate closely to branches of hyperbolæ. T. H. P.

2707. Fibre-Structure and Optical Properties of Chalcedony. C. W. Correns and G. Nagelschmidt. *Zeits. f. Krist.* 85. *pp.* 199–213, *April,* 1933.—X-Ray examination of chalcedony from different sources shows that it consists of quartz which can be "fibred" in two directions. In chalcedony from Iceland the fibre-axis is the $[11\bar{2}0]$ direction and in chalcedony from Olomuczan the fibre-axis is the $[1\bar{1}00]$ direction. The optical properties of both types may be explained on the assumption that chalcedony exhibits positive double refraction in addition to the negative double refraction of quartz. J. T.

2708. Structure of Potassium Thiocyanate. H. P. Klug. *Zeits. f. Krist.* 85. *pp.* 214–222, *April,* 1933. *In English.*—Laue and oscillation photographs are used in the determination of the structure of KNCS. It is found to be orthorhombic with four molecules in the unit cell. The dimensions of the latter are: $a = 6·66$ Å, $b = 7·58$ Å, and $c = 6·635$ Å. The space group is probably V_h^{11}. The seven parameters are evaluated by assuming that the structure is similar to that of KNCO. This assumption is found to be justified. J. T.

2709. X-Ray Study of Opals, Silica Glass and Silica Gel. I. Levin and E. Ott. *Zeits. f. Krist.* 85. *pp.* 305–318, *April,* 1933. *In English.*—In opals, crystals have been found corresponding to high-temperature cristobalite ($a_0 = 7·078 \pm 0·010$ Å at room-temperature). Certain opals contain low-temperature cristobalite and quartz. F. I. G. R.

2710. Structure of Anthracene. J. M. Robertson. *Roy. Soc., Proc.* 140. *pp.* 79–98, *April* 1, 1933.—The anthracene structure is investigated in detail. Ionisation and photographic methods are used, and a double Fourier analysis is carried out for the zones about the three crystallographic axes. The carbon rings are found to be flat, but the molecule is inclined at different angles to all the crystallographic axes. These angles are determined, likewise the 21 parameters of the structure. The peak values of electron density are highest for the carbon atoms in the meso-positions and fall off a little in the end benzene rings. The closest distance of approach of carbon atoms in adjacent molecules is 3·67 Å. The distance from atom to atom within the molecule is, however, only 1·41 Å. J. T.

2711. Crystal Structure of *o*-Iodobenzoic Acid. H. P. Klug. *Am. Chem. Soc., J.* 55. *pp.* 1430–1436, *April,* 1933.—*o*-Iodobenzoic acid is monoclinic; its unit cell has *a* 11·30, *b* 15·17, *c* 4·336 Å, *β* 90° 43′ 47″, and contains 4 molecules; space group C^5_{2h}. The iodine atoms occupy general positions with x 0·14, y 0·08, z 0·02 ; the shortest distances I–I in adjacent molecules being 3·99 and 4·36 Å. C. A. S.

2712. Structure of Cyanuric Triazide $(C_3N_3)(N_3)_3$. T. C. Sutton. *Phil. Mag.* 15. *pp.* 1001–1018, *May,* 1933.—The constituent atoms of cyanuric triazide differ in atomic number by one unit, so that conditions are favourable for a solution of the crystal structure in which the position on the lattice of every atom in the crystal is determined. Measured properties of the crystal are first detailed from which, together with some simple X-ray diffractions, the size of the elementary cell is deduced. Arguments are then proposed whereby : (i) The crystal is regarded as a number of hexagonal prisms whose edges are formed by chains of atoms. (ii) When 3 carbon and 3 nitrogen atoms are arranged in sextet rings similar to benzene, their size is such that, when placed normal to the axes of the prisms, these rings fit within and completely fill the prisms, thus supplying a mechanism for fixing the apparently arbitrary distance 2·89 Å between the parallel chains. The positions of the sextet rings in the cell and of the atoms on the edges of the hexagonal prisms are determined largely from the symmetry of the crystal. A complete model is then constructed from which cyanuric azide is found to crystallise in typically organic molecules in which the azide group is a short chain of 3 nitrogen atoms linked to the cyanuric ring by the middle nitrogen. The effective diameter of ring nitrogen is substantially the same as that of chain nitrogen. The cyanuric group resembles the benzene group and consists of an hexagonal ring of 6 atoms so arranged that the centres of neighbouring atoms are 1·44 Å apart, *i.e.*, the spheres of influence of neighbouring atoms are in contact. H. H. Ho.

2713. Macromolecular Lattice of Polyethylene Oxide. E. Sauter. *Zeits. f. phys. Chem.* 21. *Abt.B.* 3. *pp.* 161–185, *May,* 1933.—Röntgenographic comparison of high-molecular polyethylene oxides of mean molecular weights 2400, 8000, 16,000, 33,000 and 100,000 shows that these all possess the same macromolecular lattice. On elastic deformation, the rubber-like *Eu*-polyethylene oxide (100,000) yields fibres with high crystallite orientation, which have, for the dimensions of the macromolecular lattice, $a = 9{\cdot}5$, $b = 19{\cdot}5$, and $c = 12{\cdot}0$ Å., $\beta = 101°$. The space-group is probably C^4_{2h}, and the basic cell contains 36 fundamental groups. The " meander-form " of the principal valency chain of polyethylene oxide, first deduced from measurements of the viscosity, exists also in the crystalline state. On the basis of general considerations on the characteristic properties of the lattice type of the macro-thread molecules, a model for the main valency chain of polyethylene oxide is deduced. [See following Abstract.] T. H. P.

2714. Model of the Principal Valency Chain in the Macromolecular Lattice of the Polyoxymethylenes. E. Sauter. *Zeits. f. phys. Chem.* 21. *Abt.B.* 3. *pp.* 186–197, *May,* 1933.—On the basis of considerations similar to those applied in the case of the polyethylene oxides [see preceding Abstract], a new constitutional formula for polyoxymethylene is developed. A model of the basic cell of the macromolecular lattice, founded on this formula, is in accord with the X-ray, general physical, and specific chemical experimental data. T. H. P.

2715. Crystal Structure of Triphenyl. E. Hertel and G. H. Römer. *Zeits. f. phys. Chem.* 21. *Abt.B.* 4. *pp.* 292–296, *May,* 1933.—This compound forms monoclinic crystals ; translation group Γ_m, space group C^5_{2h}, $J_a = 8 \cdot 14$, $J_b = 5 \cdot 64$ and $J_c = 14 \cdot 1$ Å. $\beta = 105°$. The unit cell contains two molecules and the molecule is an elongated, rod-like structure. T. H. P.

2716. Crystalline Form of Dinitro-Cobaltammines. W. M. McNabb and H. A. Alsentzer, Jr. *Zeits. f. Krist.* 85. *pp.* 297–304, *April,* 1933. *In English.*—The crystal systems of some cobaltammines of the dinitro series are determined and their habits described. The results are tabulated below :

Salt.	*System.*	*Axial ratio, etc.*
$\left[\mathrm{Co}\begin{smallmatrix}(\mathrm{NO_2})_2\\(\mathrm{NH_3})_4\end{smallmatrix}\right]\mathrm{I}$ 1·6	Hexagonal.	$a : c = 1 : 0 \cdot 6757$
$\left[\mathrm{Co}\begin{smallmatrix}(\mathrm{NO_2})_2\\(\mathrm{NH_3})_4\end{smallmatrix}\right]_2\mathrm{CrO_4}$ 1·6	Tetragonal.	$a : c = 1 : 1 \cdot 4901$
$\left[\mathrm{Co}\begin{smallmatrix}(\mathrm{NO_2})_2\\(\mathrm{NH_3})_4\end{smallmatrix}\right]_2\mathrm{CrO_4}$ 1·2	Tetragonal.	$a : c = 1 : 1 \cdot 5034$ and $a : c = 1 : 1 \cdot 2957$
$\left[\mathrm{Co}\begin{smallmatrix}(\mathrm{NO_2})_2\\(\mathrm{NH_3})_4\end{smallmatrix}\right]_2\mathrm{Cr_2O_7}$ 1·2	Monoclinic.	$a : b : c$ $= 1 \cdot 2023 : 1 : 1 \cdot 7388$ $\beta = 115° 1'$

J. T.

2717. Dependence of Crystallisation Velocity on Molecular Structure. M. E. Krahl. *Am. Chem. Soc., J.* 55. *pp.* 1425–1429, *April,* 1933.—The velocity was determined along capillary tubes containing the molten substance, a little solid being at one end to start crystallisation. It was independent of the diameter of the tube or the direction of growth. 34 organic compounds were examined, of m.p. from $- 25 \cdot 9°$ to $+ 172 \cdot 1°$, including several pairs and trios of isomers, and giving velocities of from $< 0 \cdot 1$ to 2500 cm./sec. Of isomers the most symmetrical crystallises fastest. C. A. S.

2718. Motion of Liquid Drops on Growing Crystals. L. Kowarski. *Comptes Rendus,* 196. *pp.* 1091–1093, *April* 10, 1933.—Describes a detailed study of the motion of drops of super-cooled liquid on crystals of paratoluidine which are in process of growth from the vapour. The special technique described makes use of definite evaporating and condensing temperatures, the crystals being formed so as to hang from the cutting edge of a razor blade. J. H. A.

2719. Quantitative Crystal Analysis by X-Rays. M. E. Nahmias. *Zeits. f. Krist.* 85. *pp.* 319–321, *April,* 1933. *In French.*—The paper consists of notes additional to a previous paper [see Abstract

443 (1933)]. Brief reference is made to solid solutions and to the calibration of the films. A method for compensating the excess absorption due to a relatively dense constituent is outlined. W. E. P.

2720. Preparation of Single Crystals having a Given Axis Orientation. P. A. Palibin and A. I. Froiman. *Zeits. f. Krist.* 85. *pp.* 322–325, *April,* 1933.—The authors find that single crystals of Zn obtained by the Bridgman method are, in general, oriented so that the hexagonal axis is almost perpendicular to the tube axis. Reasons for this are suggested. The reasons are supported by the results of a series of experiments which led to the method for obtaining single Zn crystals having pre-arranged orientation of the hexagonal axis. The small tube containing the metal ends gradually in a capillary which is sealed in a thin walled sphere. The angle between the axis of the capillary and that of the tube is equal to the angle between the hexagonal axis of the crystal formed in the tube and the tube axis. Cd behaves similarly to Zn. The method is being extended to other systems, experiments with Sn being referred to. W. E. P.

2721. Diffusion in Crystals. G. v. Hevesy. *Naturwiss.* 21. *pp.* 357–362, *May* 19, 1933.—A general account, from the theoretical standpoint, of diffusion and electrolytic conduction in crystals and of chemical reactions between solid salts. Literature references are appended. L. A. W.

See also Abstracts 2691, 2723, 2739, 2740, 2743, 2799, 2997, 3001, 3041, 3044, 3059, 3160, 3178, 3183, 3228, 3229, 3230, 3266, 3267.

DENSITY.

2722. Partial Molal Volumes of Cobalt Sulphate and of Cadmium Iodide. R. C. Cantelo and H. E. Phifer. *Am. Chem. Soc., J.* 55. *pp.* 1333–1338, *April,* 1933.—The partial molal volumes at 25° C. of cobalt sulphate (0·3 to 2·25 molar) and of cadmium iodide (0·005 to 1 molar) were determined. Those of potassium chloride (0·27 to 2·29 molar) were calculated from the Gronwall-La Mer equation. Linear relations between the partial molal volume and the square root of the molal concentration were thence derived. The constants of the equations are compared with those of the corresponding theoretical equations based on the connection between the partial molal volume of the solute and that at infinite dilution derived by Redlich and Rosenfeld from the Debye-Hückel interionic attraction theory. It is confirmed that the decrease in volume produced on solution of potassium chloride is due to the physical change of volume of the salt on change from crystalline form to liquid. It is deduced that for cobalt sulphate there must in addition be a change in the volume of the water molecules due to the ion field, and that for cadmium iodide these two effects either neutralise each other or are individually negligible. P. H. B.

See also Abstracts 3001, 3087, 3116.

DIFFUSION AND OSMOSIS.

2723. Velocity of Diffusion of Metals in Gold and Silver. W. Jost. *Zeits. f. phys. Chem.* 21. *Abt.B.* 1–2. *pp.* 158–160, *April,* 1933.—The velocity of diffusion of Pd, Pt and Cu in gold and that of Pd in silver are determined within a large temperature interval by an X-ray method [see Abstract 2681 (1932)]. The relationship between temperature and velocity of diffusion is found to be of an exponential nature. J. T.

2724. Diffusion of Monatomic Gases Through Fused Silica. T. Alty. *Phil. Mag.* 15. *pp.* 1035–1048, *May,* 1933.—Reasons are given for considering the passage of inert gases through fused silica to be due to

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penetration down "cracks" of atomic dimensions. The temperature variation of the diffusion is calculated on this assumption, with the aid of the adsorption theory of Lennard-Jones. It appears that the gas atoms enter the cracks directly from the gas phase, and not from a layer of gas previously absorbed on the silica surface. From the experimental data it is possible to estimate that the energy required to remove the gas completely from the silica surface is of the order 10^4 cal./gm. atom. J. P. A.

2725. Diffusion of Mercury on Rolled Tin Foils. F. W. Spiers. *Phil. Mag.* 15. *pp.* 1048–1061, *May,* 1933.—Mercury drops placed on rolled tin foils diffuse into elliptical areas, forming an amalgam of approximately constant composition 11·8 % Hg. The shape of the area is due to the elongation of the crystallites in the direction of rolling. The crystal structure of the amalgam, determined by X-ray methods, is hexagonal. For greater concentrations of Hg than 8 %, a liquid phase exists. Investigation shows that the hexagonal phase is a secondary solid solution. A phase diagram is drawn from the experimental results. The constant composition obtained by diffusion is explained from the equilibrium of the phases at the elliptical border. J. P. A.

2726. Osmotic Pressure by the Method of Isothermal Distillation. Part II. M. Ulmann. *Zeits. f. phys. Chem.* 164. *Abt.A.* 5. *pp.* 318–326, *May,* 1933.—An apparatus already described [see Abstract 915 (1932)] is modified, and employed to investigate by the method of isothermal distillation, the osmotic pressures of dilute solutions in acetic acid of (*a*) maltoseoctacetate and (*b*) pentacetylglucose. While (*a*) obeys van't Hoff's law throughout the range of concentrations investigated, (*b*) shows signs of association at concentrations as low as 0·2 %. J. P. A.

2727. Copper Membrane Gas-Molecule Sieve: Callendar's Theory of Osmosis. D. L. Warrick and E. Mack, Jr. *Am. Chem. Soc., J.* 55. *pp.* 1324–1332, *April,* 1933.—The membrane is prepared by distilling off the zinc from a sheet of brass (32·3 % Zn) about 0·0028 cm. thick at 400–900°, the higher temperatures giving more porous membranes. $k\ [= -(dP/dt)/P$, where P is the difference in pressure on the two sides of the membrane and t the time] being constant the flow is molecular and not viscous. A membrane prepared at 475° was readily porous to H_2, N_2, CO_2 and CH_4, slightly less so to C_2H_6, much less so to *n*-pentane ($k \times 10^4 = 21{\cdot}4$, 6·78, 6·67, 8·80, 7·69, and 2·86 respectively), and impervious to benzene and ethyl ether, both of which readily pass through a membrane prepared at 600–900°. The pores of a low-temperature membrane are probably > 6 and < 20 Å in diameter. Used as a semi-permeable membrane between a sugar solution and water the osmotic flow agrees with Callendar's theory. C. A. S.

See also Abstracts 2676, 2693, 2721, 3079, 3080, 3166.

ELASTICITY AND PLASTICITY.

2728. Second Variation of the Elastic Potential of Isotropic Bodies. D. Bonvicini. *Accad. Lincei, Atti,* 17. *pp.* 69–74, *Jan.* 8, 1933. —An expression for the second variation of the elastic potential of an isotropic body is obtained to a sufficient degree of approximation for an investigation of the stability of equilibrium. The final expression for the second variation differs from the usual one by the addition of an essential term. A. J. McC.

2729. Geometrical Representation of the Theory of Bent Beams. E. Frola. *Accad. Lincei, Atti,* 17. *pp.* 287–292, *Feb.* 19, 1933.—The general theory of the bending of elastic beams under given loads is transformed to the geometrical problem of a linear transformation in a function space. The treatment is analogous to that of the linear integral equation, which is reduced to a linear point transformation in a space of an infinite number of dimensions. A. J. McC.

2730. Dynamics of the Free Transversal Vibrations of Beams, and Dynamics of the Representative Points in Space of Infinite Dimensions. E. Frola. *Accad. Lincei, Atti,* 17. *pp.* 465–469, *March* 19, 1933.—The results of a previous paper [see preceding Abstract] on the geometrical representation of the theory of elastic beams by the points of a function space are extended to the case of the free vibrations of beams. The vibrations are treated as the motion of a point in a space of infinite dimensions. A. J. McC.

2731. Breakdown of Brittle Materials. L. Prandtl. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 129–133, *April,* 1933.—A mathematical model is explained which depicts in outline the process by which an ideal non-plastic material breaks down under tensile stress. The process is considered to begin at a pre-existing minute cavity in the material, and to proceed perpendicularly to the direction of the load. Somewhat on the lines of previous work by the author, time effects in the process are considered, and applications to less ideal substances discussed. J. P. A.

2732. Strains and Stresses in a Thin-Walled Cylinder. H. Reissner. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 133–138, *April,* 1933.—By an extension of the Navier integration method, Fourier analysis is employed to solve the equations giving displacements and stresses in thin-walled hollow cylinders subjected to an arbitrary load-system. J. P. A.

2733. Buckling Load for a Rectangular Plate with Four Clamped Edges. G. I. Taylor. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 147–152, *April,* 1933. *In English.*—A formal solution to this problem is found. The forms of the displacements which satisfy both the clamped edge condition and the differential equation of neutral equilibrium are found and the magnitudes of the thrusts which are necessary in order to maintain these displacements are expressed as values which cause an infinite determinant to vanish. The case of a square plate of side $2a$, subjected to equal thrusts P perpendicular to all its edges is taken for simplicity. This plate becomes unstable when $4Pa^2/D\pi^2 > 5\cdot30$ where $D = Eh^2/12(1-\sigma^2)$, h being the thickness of the plate, E Young's Modulus, and σ Poisson's Ratio. Remarkably good agreement with Ritz's approximate method is probably accidental. Another approximation by Sezawa gives $5\cdot61$ as the critical value. J. P. A.

2734. Stresses in Perforated Plate. Y. Nakagawa. *Ryojun Coll. Eng., Mem.* 6. 2. *pp.* 35–48, *March,* 1933. *In German.*—In an elastic plate are two small circular holes of the same radius. From these an aperture is made by removing the intervening portion bounded by the exterior common tangents. By an approximate method the stresses surrounding the aperture when the plate is extended, are found. It appears that the large stresses near the edge of the separate circular holes, are diminished when the separating portion is removed. The results are tested with a transparent sample viewed in polarised light. J. P. A.

2735. Stability of Elastic Equilibrium. E. Trefftz. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 160–165, *April,* 1933.—A set of small displacements in an elastic body increase the internal energy by $d\mathrm{E}$. If $d\mathrm{E} > d\mathrm{A}$, where $d\mathrm{A}$ is the work done by the external forces, the body is in stable equilibrium. The limit of stability is thus given by $d\mathrm{E} = d\mathrm{A}$. On this basis, the general theory of elastic stability is worked out, and applied to the case of a cantilever loaded at one end. J. P. A.

2736. Equilibrium of a Tooth with a General Conical Root. J. L. Synge. *Phil. Mag.* 15. *pp.* 969–996, *May,* 1933.—Continuing previous calculation [see Abstract 2166 (1933)] the elastic problems connected with the equilibrium of a rigid cone which is not right circular, held in a socket by a membrane of uniform thickness, are discussed. The distribution of pressure in the membrane, when the cone is subjected to a specified load system, is found. J. P. A.

2737. Impulsive Vibrations. R. Förster. *Arch. f. Elektrot.* 27. *pp.* 307–321, *May* 2, 1933.—An oscillating system is investigated in which the restoring force is a periodic function of position rather than of time. By suitable transformations a periodically varied damping may be introduced. The problem is stated and solved in such a way that it applies approximately to a type of periodic perturbation occurring in electrical machines, *e.g.*, " hunting " in coupled alternators, and which sometimes produces drumming or rattling. J. P. A.

2738. Elastic Constants of Woods. J. Stamer and H. Sieglerschmidt. *V.D.I.* 77. *pp.* 503–505, *May* 13, 1933.—The elastic moduli of samples of oak, beech and Oregon pine are measured parallel and perpendicular to the fibres. From the results it appears that for each material the quantity $\mathrm{E}k^{\frac{1}{2}}/\mathrm{G}$ is the same for measurements in all three directions. E and G are moduli for extension and torsion along and about the same principal axis respectively, and k is the increase in volume per unit longitudinal stress in the same direction. Again, if μ_r, μ_t are lateral contractions in radial and tangential directions, relations such as $\mu_r/\mu_t = \mathrm{E}_t/\mathrm{E}_r$ hold approximately. A comparison with similar relations for metals is made.
J. P. A.

2739. Elastic Properties of Gold-Silver Single Crystals. H. Röhl. *Ann. d. Physik,* 16. 8. *pp.* 887–906, *April,* 1933.—The elastic moduli for torsion and extension for gold-silver monocrystals of various compositions are measured by a method similar to that employed by Grüneisen and Goens [see Abstract 2659 (1924)]. Elastic anisotropy is as pronounced as in the pure component metals. The velocity of sound in various directions is calculated. Bruggeman's theory of quasi-isotropic metals and alloys is borne out by the relations between the elastic moduli. The Debye " characteristic temperatures " are calculated for the crystals.
J. P. A.

2740. Tensile Strength of Mica. E. Orowan. *Zeits. f. Physik,* 82. 3–4. *pp.* 235–266, *April* 29, 1933.—The tensile strength of ruby mica, found by loading thin strips about 20mm. wide, held in a 20mm. wide clamp is 6800 kg./cm.^{2}. When the strip is made wider than the clamp, so as to free the edges from stress, the strength rises to 30,000 kg./cm.^{2}. The low values usually found are due therefore to tearing from the edges. Abnormally low values ordinarily found for rock-salt are probably due to the same cause. *Errata, ibid.,* 83. 7–8. *p.* 554, *June* 28, 1933. J. P. A.

2741. Surface Waves in a Visco-Elastic Medium. T. Itoo. *Kyushu Univ., Faculty of Eng., Mem.* 7. 1. [87 *pp.*] 1933. *In German.*—A visco-elastic medium is defined in which the stresses are governed by a stress dyad $\Psi = (\lambda + \lambda'\frac{\partial}{\partial t})\,\theta I + 2(\mu + \mu'\frac{\partial}{\partial t})\Phi$, where I and Φ are the unit and deformation dyads respectively, θ is the dilatation, λ, μ Lamé's constants, λ', μ' constants corresponding to Lamé's. On this basis the theory of elastic waves in the medium is developed very generally, but with the special aim of developing the theory of surface waves as encountered in seismological work. Properties of deep-seated seismic waves are also considered. J. P. A.

2742. Energy Absorbed in Cold-Working of Metals. W. Rosenhain and V. H. Stott. *Roy. Soc., Proc.* 140. *pp.* 9–25, *April* 1, 1933.—Of the work expended in plastically deforming a metal, a small percentage does not reappear as heat, but remains latent. To measure this quantity, wires are drawn, under a controlled tension, through a die, and the heat produced measured in a calorimeter surrounding the die. Serious difficulties are encountered in estimating the corrections accurately. In Al wires, about 1·2 % of the energy of deformation is retained by the metal, in annealed Cu, 3·1 %, and in hard Cu, 0·5 %. An exact comparison with the results of Farren and Taylor [see Abstract 1764 (1925)] is not possible owing to differences in the cold working of the metals, but their conclusions are approximately confirmed. J. P. A.

2743. Improved Apparatus for Static Measurements of Torsional Modulus of Crystal Rods and Application to Single Crystals of Zinc. E. Goens. *Ann. d. Physik*, 16. 7. *pp.* 793–809, *April*, 1933.—A description is given of an improved form of torsion apparatus for use with crystal rods. Numerical results are given for single crystals of zinc, the test-pieces used being the same as were previously used by Grüneisen and Goens. The values for the principal elastic parameter of single crystals of zinc are changed slightly from the earlier results, but the agreement with Bridgman's results is still unsatisfactory. [See also Abstract 862 (1933).] A. W.

See also Abstracts 2756, 2782, 2832, 2906, 2907, 3230, 3235, 3236.

GRAVITATION.

2744. Magnetisation of Invar Pendulums. E. C. Bullard. *Cambridge Phil. Soc., Proc.* 29. *pp.* 288–296, *May* 10, 1933.—The susceptibility of invar pendulums used for relative gravity determinations to magnetisation, introducing changes in the period of oscillation which may amount to 48 × 10^{-7} sec., is investigated. Values of the induced magnetic moment varied in the tests on six pendulums between 160 and 310 e.m.u. per gauss of the inducing field, which ranged between − 0·5 and + 0·5 gauss. The maximum magnetic moments induced by tapping the pendulums in the earth's field were of the order of 150 e.m.u. Demagnetisation is not easy, and changes in the magnetic moment may easily be caused by small jars in transferring the pendulum from its case. The variation of the period with the magnetic moment is approximately linear. The effects may be largely eliminated by lining the pendulum case with a mu-metal screen, 0·025 cm. thick, which reduces the change in period to about 1 × 10^{-7} sec. E. L. J.

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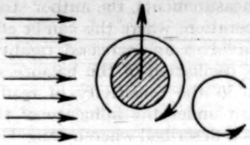
2745. Decreasing the Time of Gravity Torsion Balance. J. W. Joyce. *Bureau of Mines, Techn. Paper* 546. [46 *pp.*] 1933.—After reviewing the theory of the Eötvös torsion balance and outlining the field procedure in gravity measurements, the author stresses the importance of reducing the time of operation, where this can be effected without decrease of sensitivity. This involves an increased rigidity in the torsion fibre, giving a less period of oscillation of the balance system, necessitating a corresponding increase in the sensitivity of reading the small angular deflection of the system under the influence of the gravitational forces. A laboratory apparatus is described whereby angular deflections as small as 10^{-8} radian can be detected. The apparatus comprises a source of light which serves to illuminate two screens, each of which is divided into alternate opaque and transparent slits of width one fiftieth of an inch. The light, after passing through the first screen, is reflected from a concave mirror mounted on the torsion member and brought to a focus in the plane of the second screen, of which normally one half the slits are in step and the other half out of step with those of the first screen. To effect this, the second screen has a central opaque slit of twice the normal width. When the torsion mirror is untwisted, light passes through one half only of the second screen; any twist of the mirror allows a proportional amount of light to traverse the other half, whilst diminishing correspondingly the light traversing the first half. The amount of illumination traversing each separate half is made to actuate a photoelectric cell, and the two cells are made the ratio arms of a Wheatstone bridge, which is balanced by means of a variable resistance. The change in this resistance necessary to effect balance is a very sensitive measure of the angular deflection of the torsion mirror. Actual tests in the laboratory showed that angles as small as 2×10^{-8} radian could be detected. If a device of this type could be adapted to a gravity torsion balance, the period of oscillation could be reduced to 20 sec., as compared with the present standard construction in which the period is from 14 to 30 min. E. L. J.

2746. Direct Measurement of the Gravitational Effect of the Moon. K. Hartley. *Physics*, 4. *pp*. 162–163, *April*, 1933.—The sensitivity of the gravity balance [see Abstract 2658 (1932)] is such that a correction must be made for the effect of the attraction of the moon. This lunar effect has been measured by hourly readings over one complete cycle and agrees, within the observational error, with the effect calculated for the vertical component of the pull of the moon without any compensation for the centrifugal effect of the earth's motion around the centre of gravity of the system. The effect has a period of 24·8 hours and not 12·4 hours as the tides, there is no trace of the 12-hour period. Values of gravity plotted against time follow accurately a sine curve which shows a small time-lag as compared with the theoretical curve. This does not seem to be accidental, but has not been explained. AUTHOR.

See also Abstract 2911.

HYDRODYNAMICS AND AERODYNAMICS.

2747. Rotation of Cylinder Moving Across a Wind Stream. O. C. Hilgenberg. *Zeits. f. techn. Physik*, 14. 5. *pp*. 211–214, 1933.—The author defines the inverse of the Magnus effect as the production of two cylindrical eddies in a stream of fluid when a cylindrical body moves perpendicularly to the stream. One eddy surrounds the body as shown in the accompanying Fig. The author has investigated this effect both in the case of a water stream and, indirectly, in the case of an air stream and he



finds that the effect exists as would be anticipated on general theoretical grounds, *i.e.*, that the body exhibits a tendency to rotate. J. W. T. W.

2748. Movement of a Rectilinear Vortex about a Deflector. G. Hamel. *Zeits. f. angew. Math. u. Mechanik.* 13. *pp.* 98–101, *April*, 1933. —Considerations of finite velocities and energies at critical points lead for a particular case (No. 1 of an intended series) to (1) general equations for parallel vortex-lines in an ideal incompressible fluid; (2) movement of a rectilinear vortex about a deflector; (3) integration of the differential equations; (4) discussion of the vortex-paths; (5) bilaterally limited plates. A. D.

2749. Excitation of Waves in a Canal by Motion of a Transverse Boundary. J. M. Burgers. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 67–71, *April*, 1933.—The excitation of stationary waves in an infinite channel filled with fluid, by the motion of a tranverse wall bounding the channel at one end is discussed mathematically. J. S. G. T.

2750. Permanent Waves in a Circular Canal of Arbitrary Section. A. Gay. *Comptes Rendus,* 196. *pp.* 1462–1464, *May* 15, 1933.—Supplementing work by Levi-Cività and by Geppert, the author discusses wave propagation in fluid contained in a circular channel of arbitrary cross section. J. S. G. T.

2751. Fluid Motion Round a Cavitation. H. Poncin. *Comptes Rendus,* 196. *pp.* 756–757, *March* 13, 1933.—A mathematical study of the initial movement of a fluid mass and the final amount of drag which must be imparted to the solid limiting surfaces to ensure the stability of a cylindrical cavitation. E. E. F. d'A.

2752. Turbulent Flow. G. D. Mattioli. *Accad. Lincei, Atti,* 17. *pp.* 217–223, *Feb.* 5, *and pp.* 293–299, *Feb.* 19, 1933.—Develops a theory of permanent turbulent flow in cylindrical tubes of circular cross-section, assuming the turbulence to have been already set up and its position in the tube established. A. D.

2753. Dynamic Considerations Relating to a Statistical Theory of Turbulence. F. Noether. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 115–120, *April*, 1933.—A statistical theory of turbulence, utilising ideas incorporated in Kármán's experimental results and hypothesis of similarity, is developed. J. S. G. T.

2754. Propagation of Turbulence in a Free Jet. P. Ruden. *Naturwiss.* 21. *pp.* 375–378, *May* 26, 1933.—The propagation of turbulence in a jet of fluid issuing into a volume of the same fluid is discussed theoretically. J. S. G. T.

2755. Growth of Vortex Motion in Water Running from a Tank. S. Watanabe. *Geophys. Mag., Tokyo,* 7. *pp.* 37–44, *April,* 1933. *In English.*—When the plug of a water tank is removed the escaping water usually has a rotational motion which, although it may be weak at the start, will soon grow very strong. This phenomenon is explained by means of a new equation of motion. AUTHOR.

2756. New Term in the Equation of Motion in Hydrodynamics and in the Theory of Elasticity. S. Fujiwhara. *Geophys. Mag., Tokyo,* 7. *pp.* 45–49, *April,* 1933. *In English.*—Discontinuity of fluid motion, more especially in connection with the equation of fluid motion referred to by Watanabe [see Abstract 879 (1933)], is briefly discussed. J. S. G. T.

2757. Modification of Oseen's Approximate Equation for the Motion in Two Dimensions of a Viscous Incompressible Fluid. R. V. Southwell and H. B. Squire. *Roy. Soc., Phil. Trans.* 232. *pp.* 27–64, *April* 21, 1933.—A modification, alternative to that proposed by Oseen, of the exact equations of steady motion in two dimensions, past a fixed cylindrical object, of an incompressible viscous fluid, is proposed. The resulting equation for vorticity has the same form as Oseen's in one case, *viz.*, when the cylinder is a flat plate presented edgeways to the stream. In other cases the vorticity equation can be given the form of Oseen's equation, provided Cartesian coordinates are replaced by coordinates appropriate to the shape of cylinder. The modified equations are solved by approximate methods (largely graphical) for (*a*) the flat plate, and (*b*) the circular cylinder. J. S. G. T.

2758. Forced Rotation of Viscous Fluid. L. Sona. *Accad. Lincei, Atti,* 17. *pp.* 79–82, *Jan.* 8, 1933.—A mathematical treatment of the problem of the rotational flow of a viscous fluid in a cylinder, it being assumed that the tangential force is proportional to the distance from the axis. The second part of the paper deals with the flow of a fluid enclosed within two coaxial cylinders rotating at given velocities. J. W. T. W.

2759. Motion of a Viscous Fluid in the Neighbourhood of a Cylinder Rotating Uniformly, and the Law of Similitude. M. Luntz and P. Schwarz. *Comptes Rendus,* 196. *pp.* 1465–1467, *May* 15, 1933.—The motion of fluid in the neighbourhood of a rotating cylinder is discussed briefly from the experimental and theoretical standpoints in connection with previous work by the authors [see Abstract 2187 (1933)] and by Escande and Dupin [see Abstract 1725 (1933)]. J. S. G. T.

2760. Slow Rotation of a Circular Cylinder in a Viscous Fluid Bounded by Parallel Walls. R. C. J. Howland and R. C. Knight. *Cambridge Phil. Soc., Proc.* 29. *pp.* 277–287, *May* 10, 1933.—Modified solutions of equations previously used in the discussion of problems in the theory of elasticity [see Abstracts 2903 (1929) and 2072 (1930)] are derived and applied to derive the stream function associated with the slow rotation of a cylinder arranged symmetrically between parallel walls. J. S. G. T.

2761. Excentric Descent of Spheres in Hollow Cylinders containing Liquid or Gas. F. Höppler. *Zeits. f. techn. Physik,* 14. 4. *pp.* 165–169, 1933.—The rate of fall of spheres (radius r) in tubes (radius R) is investigated experimentally. Amongst the results obtained are (1) the sphere acquires the greatest velocity of fall for the case $R^2/r^2 = 3$, (2) when the value of t/s, t denoting time to fall distance s, is less than 6 the motion of the fluid is turbulent. The application of the results to the construction of a practical form of accurate viscometer is discussed. J. S. G. T.

2762. Inertia Law of Small Spheres in Frictional Media. E. Wasser. *Phys. Zeits.* 34. *pp.* 257–278, *April* 15, 1933.—A survey is given of theoretical and experimental investigations of the problem of the accurate determination of the weight of microscopic and sub-microscopic particles. While other methods are mentioned, the summary deals almost entirely with investigations which seek in a purely mechanical way to determine the size of a single particle from its velocity of fall in frictional media. Investigation of the inertia law is considered (1) without consideration of slipping and (2) with consideration of slipping. The review starts with the paper in which Stokes in 1851 gave the law of the slow motion of a sphere in an incompressible fluid. It can be affirmed that the Stokes-Cunningham law for particles of definite constitution and form permits a correct determination of magnitude to be obtained. Those particles for which the fulfilment of these conditions cannot be assumed must be examined in each special case by means of the pressure method as to their structure and mean density. J. J. S.

2763. Flow of Water through Fine Clearances. R. J. Cornish. *Roy. Soc., Proc.* 149. *pp.* 227–240, *April* 1, 1933.—Experiments on the resistance to flow of water through a series of fine annular clearances in which the cylindrical bush forming the internal boundary could be rotated. In the laminar flow region the resistance is unaffected by rotation at low speeds, but is increased when the angular velocity rises above a certain critical value. In the region of turbulent flow the effect of a given speed of rotation diminishes as the Reynolds number increases; this part of the work was correlated with that of Suzuki. A. D.

2764. Mechanical Imitation of Flight of Birds and Winged Insects. G. Castagneris. *Accad. Lincei, Atti,* 17. *pp.* 281–286, *Feb.* 19, 1933.—Describes a mechanical device which gives an imitation of the movement of a wing during flight and enables measurements of the power expended at various speeds to be obtained. It is found that the results agree well with the estimates made by Lendenfeld for birds and insects of various kinds. J. W. T. W.

2765. Hot-Wire Apparatus for the Study of Air Movements Produced by the Flapping Wing of a Bird or Insect. A. and C. Magnan. *Comptes Rendus,* 196. *pp.* 1369–1372, *May* 8, *and pp.* 1698–1700, *May* 29, 1933.—Apparatus comprising a hot wire anemometer, a valve amplifier and a kinematographic film recorder is briefly described. J. S. G. T.

2766. Speedometer to Indicate True Airspeeds. T. Sasaki and T. Yosida. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 95. *pp.* 395–415, *March,* 1933. *In English.*—Describes a differential pressure type airspeed indicator in which the variations in the density of the air are compensated. The mechanism is described and illustrated in the paper, and from the quoted results of tests carried out in the low-pressure, low temperature wind tunnel of the Institute it appears that the compensation is very accurate. J. W. T. W.

2767. Wind Pressure on a Model of the Empire State Building. H. L. Dryden and G. C. Hill. *Bureau of Standards, J. of Research,* 10. *pp.* 493–523, *April,* 1933.—The pressure was measured at 102 stations on the model, 30 of which represent stations in the actual building, at 11 wind directions. In addition, the overturning moments were measured for the same wind directions. The results show that the pressure varies from point to point, and that reduced pressure is found over the larger part of the model. The greatest loads on the building occur when the wind blows directly against one face. A suitable value of the pressure for use in the design of tall buildings is 0·0038 V^2 (in lbs./ft.^{2}) where V is the wind speed in miles per hour against which provision is to be made. It was found that the speed of the air rushing by close to the building is greater than that of the approaching wind. Hence, an instrument mounted 15 feet above the top of the building reads too high by a factor 1·23. An outline is given of a method of procedure for the comparison of the results on the model with those on the actual building. AUTHORS.

See also Abstract 2834.

KINETIC THEORY OF MATTER.

See Abstracts 2666, 2762, 2799, 2830, 2957, 2983, 3075, 3079, 3080, 3103.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

2768. Amplifying Lever for Measurement of Small Displacements. G. A. Fink and G. W. Fox. *Rev. Sci. Instruments,* 4. *pp.* 276–279, *May,* 1933.—An amplifying lever system used for measuring piezoelectric deformations of quartz and tourmaline plates is described. Interference fringes are formed between a semi-transparent coating of silver on glass and a mirror on the long end of a lever. With an arm ratio of 1864 to 1 the sensitivity of the lever is such that a displacement of a knife edge on the short end of about 0·15 Å can be detected. The chief difficulty in its use was found to be disturbance from vibrations. Sources of error, possible improvements, and possibilities for other uses are discussed. AUTHORS.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

2769. New Method for the Exact Calculation of the Fourier Coefficient. G. Dietsch and B. Rotzeig. *Gerlands Beitr. z. Geophys.* 38. 3–4. *pp.* 276–281, 1933.—A numerical procedure is described which permits the determination of a much better approximation to a given periodic function than has been possible hitherto in a numerical way. In place of the former step curve the function is replaced by a polygonal path. It is possible with the help of the derived formula to correct subsequently by multiplication the value of the coefficient calculated by the old procedure with the help of a correction factor. Apart from its simplicity it is claimed that the method is not limited to the periodic curve and it leads to greater accuracy. R. S. R.

2770. Graphical Method for the Integration of Emden's Equation. J. Dick. *Zeits. f. Astrophysik,* 6. 3. *pp.* 207–212, *April* 8, 1933.—A purely graphical method for finding the integral curve of Emden's equation is given, the radius of curvature and inclination of the tangent of the integral curve being used as variables. A determination of the solution for $n = 2$ is made by this method and is in fairly good agreement with the computed solution. G. C. McV.

2771. Gauss's Proof of the Normal Law of Errors. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 29. *pp.* 231–234, *May* 10, 1933.—The paper deals with Gauss's proof of the normal law of errors and proceeds to show that the normal law does not hold in the important practical case in which the interval to be measured is found by reading both ends to the nearest multiple of the finite step of the measuring instrument, although the arithmetic mean is the most probable value. It is shown that in Gauss's theory the observations are supposed capable of an indefinite range of values, whilst in the practical case only two observed values are possible. J. S. C.

2772. Extremely Simple Method of Periodogram Analysis. D. Alter. *Nat. Acad. Sci., Proc.* 19. *pp.* 335–339, *March*, 1933.—Given n data, in the form of departures from the mean of all; add all the pairs separated by a time-interval l and sum the absolute values of all such sums; this sum divided by the number of pairs is denoted by M; and the periodogram is the graph of M against the various trial values of l. M will clearly be increased by any degree of repetition in the data. Its relation to the correlation coefficient is derived. The method is adapted to computing machines. It is illustrated from variable star R. Scuti. [See Abstract 2266 (1933).] T. L. M.

2773. Partial Reversal of the Smoothing due to Measuring Instruments. Ellen Gschwind and W. Lohmann. *Zeits. f. techn. Physik*, 14. 4. *pp.* 169–172, 1933.—An instrument intended to measure a varying quantity (*e.g.*, wind velocity) cannot follow all the variations, but smooths them, giving as its reading the quantity $F(x, a)$, instead of $\phi(x)$. Here a is the "smoothing constant" of the instrument and $F(x, a) = \int \phi(x)\,dx$ taken between the limits $x \pm a/2$. The problem dealt with is to reverse this process, so as to deduce ϕ when F is given. The approximate result found is $\phi = F - a^2F''/24 + 7a^4F^{(4)}/5760$, accents denoting differentiations with respect to x. The problem is extended to the case of multiple smoothing, an example of double smoothing being when a width a from a spectrum, falls on a bolometer with slit-width b. J. H. A.

See also Abstracts 2793, 2796, 2998, 3213.

MECHANICS, CLASSICAL.

2774. Problem of *n* Bodies Mutually Attracting as Any Power of the Distance. M. Kiveliovitch. *Accad. Lincei, Atti*, 17. *pp.* 224–227, *Feb.* 5, 1933.—Continuing a former paper [see Abstract 473 (1933)], deduces the following theorem: The problem of 3 bodies gives at most one binary shock for movement in space and two for plane movement. In the general case of n bodies, there will be a maximum of $(2n–5)$ shocks for movement in space and $(2n–4)$ for plane movement. A. D.

2775. Problem of *n* Bodies with Variable Masses. M. Mendes. *Comptes Rendus*, 196. *pp.* 845–848, *March* 20, 1933.—In the problem of three bodies calculations according to Lagrange show that the determination of mutual distances depends in general upon a system of three differential equations two of the third order and one of the second order. The case where the distances remain in a constant ratio can also be studied by

Lagrange's method, or the same problem may be extended to *n* bodies by the method given by Andoyer in 1906. E. E. F. d'A.

2776. Forces of Inertia of a System and Relative Motion. Saintillan. *Comptes Rendus,* 196. *pp.* 1159–1161, *April* 18, 1933.—The absolute forces of inertia of a system which is in motion relative to a given moving frame of reference are considered, and a new expression is obtained for the resultant moment of the composite centrifugal forces. A. J. McC.

2777. Integration of Canonical Systems of One Degree of Freedom. G. Lampariello. *Accad. Lincei, Atti,* 17. *pp.* 74–78, *Jan.* 8, 1933.—The canonical equations of a dynamical system of one degree of freedom are considered in the case where the curves of constant energy in the phase space are closed and without double points, and it is shown how their solution can be written in a simple periodic form. A. J. McC.

2778. Reduction of Order of Canonical Systems. R. Einaudi. *Accad. Lincei, Atti,* 17. *pp.* 546–551, *April* 2, 1933.—An extension of Sophus Lie's second theorem, and a simpler proof of that theorem than that given by Lie. Mathematical. A. D.

2779. Equations of Motion of Dynamical Systems. T. Boggio. *Accad. Lincei, Atti,* 17. *pp.* 452–460, *March* 19, 1933.—The motion of a dynamical system of *n* degrees of freedom is represented by the motion of a point in a subspace of *n* dimensions immersed in a Euclidean space of higher dimensions. A. J. McC.

2780. Motion of Surfaces, Curves and Points Associated with Groups of Waves. B. Finzi. *Accad. Lincei, Atti,* 17. *pp.* 460–464, *March* 19, 1933.—Continuing the discussion of groups of waves [see Abstract 1751 (1933)] groups of the first, second and third orders are defined. The first possess surfaces of equal phase, the second curves of equal phase and the third points of equal phase; and the motion of these surfaces, curves and points is discussed. A. J. McC.

2781. Gyroscopic Movement of Stable Projectiles. R. d'Adhémar. *Comptes Rendus,* 196. *pp.* 899–900, *March* 27, 1933.—Shows how to develop a set of equations on the basis of a mobile tetrahedron of reference. Application to the study of the velocity of rotation of the projectile. A. D.

2782. Percussion in Wires. H. Pailloux. *Comptes Rendus,* 196. *pp.* 1460–1462, *May* 15, 1933.—The following problem is discussed mathematically: knowing the form of a wire and the velocities of its parts at a given time, determine the new distribution of velocities in the wire after each part of the wire is subjected to an external impulse. J. S. G. T.

2783. Mathematical Foundation of Statistical Mechanics. A. Khintchine. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 101–103, *April,* 1933.—Works in the field opened up by Birkhoff's conception [see Abstract 2302 (1932)], which apparently arrived too late for the newer Physics, though it retains validity for pure mathematics. Does not admit of abstracting. A. D.

2784. Metrically Transitive System. W. Seidel. *Nat. Acad. Sci., Proc.* 19. *pp.* 453–456, *April,* 1933.—The notion of metrically transitive systems was introduced by G. O. Birkhoff and P. A. Smith. Birkhoff has been led to a certain fundamental transformation whose metrical transitivity seemed likely. The author establishes the validity of this conjecture, and fully considers the transformation in question. A. D.

2785. Theory of the Reduction of Acceleration Data. R. L. Edwards. *Am. Phys. Teacher,* 1. *pp.* 36–40, *May,* 1933.—The common methods of treating acceleration data in the student laboratory are discussed and the relative probable errors due to the random character of the spark are analysed theoretically. Time-intervals are assumed free from progressive or cumulative errors. A general formula is obtained which, if used properly, not only gives more reliable results, but simplifies calculations. The proper use of the formula is determined for the general case. AUTHOR.

2786. Accelerometer with Rolling Contact. F. Charron. *Comptes Rendus,* 196. *pp.* 1365–1367, *May* 8, 1933.—An accelerometer comprising a Wheatstone bridge and oscillographic indicator or recorder, suitable for use, *e.g.*, in aeroplanes, is described. J. S. G. T.

See also Abstracts 2744, 3114.

MECHANICS, QUANTUM.

2787. Dirac's New Theory of the Electromagnetic Field. S. Schubin. *Phys. Zeits. d. Sowjetunion,* 3. 4. *pp.* 338–350, 1933. *In English.*—The connection is discussed between Dirac's new treatment [see Abstract 3581 (1932)] of atomic problems and the usual one (for the unrelativistic case). It is shown that the latter has led to results which are in agreement with experiment only by the inconsequent application of the rules of quantisation of the electromagnetic field. The only consequent way of obtaining these results is offered by Dirac's new theory. This theory gives, however, no way of avoiding the main difficulties of quantum electrodynamics (in particular the difficulty of the infinite self-energy of the electron). AUTHOR.

2788. Operational Theory of the Dirac Wave Equation. S. Gupta. *Zeits. f. Physik,* 82. 5–6. *pp.* 408–414, *May* 8, 1933.—The mathematical analogy between the free electron and electromagnetic waves, already derived by de Broglie [see Abstract 4802 (1932)] is here deduced from a consideration of the operators themselves, and not the densities as in de Broglie's treatment, in Schrödinger's calculus of operators relating to α-matrices. J. S. G. T.

2789. Spatial Quantisation. R. Frisch and E. Segrè. *N. Cimento,* 10. *pp.* 78–91, *Feb.,* 1933.—Experimental study of the changes in spatial quantisation caused by the rotation of a magnetic field, both in the adiabatic and the non-adiabatic case. In the non-adiabatic case, these changes are governed by the fundamental equations of quantistic mechanics of non-stationary systems. Some methods are discussed whereby such changes may be determined by exchange of electrons. A. D.

2790. Exchange Energy. V. Fock. *Zeits. f. Physik,* 81. 3–4. *pp.* 195–208, *March* 11, 1933.—It is shown that in the case of an alkali atom it is possible to allocate to the exchange energy of the valency electron a linear operator. The classical quantity corresponding to this operator is found. The one-body problem in which exchange is taken into consideration (the wave-equation of the valency electron) is first formulated in the non-relativistic Schrödinger form and then in the relativistic Dirac form. The doublet resolution of the alkali terms is also discussed. H. L. B.

2791. Vector Model and the Pauli Principle. M. H. Johnson, Jr. *Phys. Rev.* 43. *pp.* 627–631, *April* 15, 1933.—The vector model is examined in the light of the quantum theory of wave fields. First the distributions of electrons among the electronic states are limited to correspond to the atomic states arising from one electronic configuration. A set of independent angular momentum vectors $l_1, l_2, \dots s_1, s_2 \dots$ is found, in which one orbital and one spin vector are associated with each group of electronic states, rather than individual electrons, having given values of the quantum numbers n and l. Any other vector T may be decomposed into a sum of independent vectors t_i, one associated with each of the same group of electronic states. The usual commutation relations obtain among the vectors t_i, l_i and s_i. On further limiting the distributions to correspond to atomic states arising from electronic configurations containing no equivalent electrons, it is shown that the matrix of $\Sigma_k f(l_k^0, s_k^0)$ (an operator in coordinate space in which f is any algebraic function of the components of l and s)can be constructed from the vectors $l_1, l_2, \dots s_1, s_2, \dots$ according to the usual laws of matrix mechanics. [See Abstract 1976 (1932).]

AUTHOR.

2792. Almost Closed Shells. M. H. Johnson, Jr. *Phys. Rev.* 43. *pp.* 632–635, *April* 15, 1933.—Heisenberg's treatment of an almost closed shell [see Abstract 48 (1932)] is extended to electronic configurations consisting of several almost closed shells plus other electrons not in the shells. In this way Shortley's results [see Abstract 3269 (1932)] are obtained with additional information about the nondiagonal matrix elements of the electrostatic energy. The results of calculating the electrostatic energies by this method are presented for the configurations p^5p, d^9d and d^9p.

AUTHOR.

2793. Equations with Hamiltonians Dependent on Time, and Resonance Phenomena in Wave Mechanics. J. Winter. *J. de Physique et le Radium*, 4. *pp.* 132–137, *March*, 1933.—The possibility is examined of extending to non-stationary problems (interaction phenomena of matter and radiation, and resonance) the classical wave mechanics in which the Hamiltonian is dependent on the time. A wider application of the relation $\Delta E . \Delta t \geq h$ is proposed. N. M. B.

2794. Wave-Mechanics as Hamiltonian Mechanics in Function-Space. C. Lanczos. *Zeits. f. Physik*, 81. 11–12. *pp.* 703–732, *April* 18, 1933.—The solution of any partial differential equation, which arises from a variational problem, can be found as the solution of the Hamiltonian equations of motion of a dynamical system in the Hilbertian function-space defined by the partial differential equation. The solution of the Hamiltonian equations is determined by the use of a contact-transformation which reduces the set to a self-adjoint one. Dirac's linear equations for the electron then arise identically by application of this method to the variational problem which gives the equations of the electromagnetic field. The fact that the contact-transformation used in the function-space problem is not unique corresponds to the possibility of choosing different sets of orthogonal matrices in Dirac's linear set of wave-equations. The method brings out clearly the incompatibility of trying to interpret an electron as being both a " wave " and a " particle " in the same " space."

G. C. McV.

2795. Application of the Method of Phase-Integrals to the Hydrogen Ion. E. M. van Engers and H. A. Kramers. *Zeits. f. Physik*, 82. 5–6. *pp*. 328–336, *May* 8, 1933.—It is shown that in the case of H_2^+ the approximate determination of the stationary states can be carried out by means of an improved phase-integral method (the method of Brillouin, Wentzel and Kramers). For the normal state good agreement is found with the results of Burrau and Teller. G. G. S.

2796. Successive Approximations by the Rayleigh-Ritz Variation Method. J. K. L. MacDonald. *Phys. Rev.* 43. *pp*. 830–833, *May* 15, 1933.—Approximate eigenvalues given by the Rayleigh-Ritz variation method for handling linear differential equations are examined, and relations are established between the discrete eigenvalues obtained in successive approximations. These relations should be of use in practical computations. A method for fixing upper limits to eigenvalues is given, and a procedure previously employed by the writer [see Abstract 253 (1933)] to simplify determinant calculations is adapted for use in the present theory. AUTHOR.

2797. Wave Mechanical Theory of Refraction. J. A. Wasastjerna. *Soc. Scien. Fennica*, 6. 18. *pp*. 1–11, 1932–1933. *In English.*—A formula for the refraction equivalent for a system consisting of p identical outer electrons obtained on the assumption that the statistical density distribution oscillates with a frequency due to the light wave and that radiation is determined by the electric moment of the oscillatory system, can also be obtained from the energy quantity corresponding to the second-order Stark effect in hydrogen-like atoms. It is shown that a comparatively simple connection exists between atom or ion refractions and the distribution of electrons in the outer parts of the atoms or ions respectively. A solution of Schrödinger's wave-equation with a potential function of a more general nature than the Coulomb potential is obtained for rare gas atoms and ions of rare gas type. For $p = 8$, the atomic or ionic refraction is nearly proportional to $\bar{r}^4$, $\bar{r}$ being the mean distance of the outer ring of electrons from the nucleus. G. G. S.

2798. Electron Distribution in Atoms and Ions. J. A. Wasastjerna. *Soc. Scien. Fennica*, 6. 19. *pp*. 1–14, 1932–1933. *In English.*—The electron distribution curve for an atom or ion of rare gas type is calculated as an analytic function of the refraction equivalent. The resulting curves are compared with the curves obtained by Hartree's method of the self-consistent field. A fairly satisfactory conformity is found between the curves calculated in different ways. G. G. S.

2799. Wave Mechanical Significance of the Apparent Radii of Atoms and Ions. J. A. Wasastjerna. *Soc. Scien. Fennica*, 6. 21. *pp*. 1–13, 1932–1933. *In English.*—A proportionality is found to exist between the most perfectly defined empiric radii, *i.e.*, the apparent radii in crystal lattices and those which appear in kinetic gas theory, and the structure and geometrical extension of the electronic systems. It is found that the electron distribution in the outer parts of rare gas atoms and ions of rare gas type can be expressed by the formula $\eta = 5/3\ (5\xi)^4 e^{-5\xi}$, where $\eta = D\bar{\rho}$ and $\xi = r/\bar{\rho}$. D denotes the electron distribution, r is the distance from the nucleus, $\bar{\rho}$ is a quantity of length dimension, characteristic of the system in question and given by $10\ \bar{\rho}^4 = I$, the refraction equivalent.

The values $\xi = \xi_0$ which correspond to the apparent radii $r = \rho_0$ of the atoms or ions, are constant for all ions of rare gas type in ionic lattices of the same structure. G. G. S.

2800. Forces between Atoms and Ions. J. A. Wasastjerna. *Soc. Scien. Fennica,* 6. 22. *pp.* 1–15, 1932–1933. *In English.*—The potential of repulsion for two ions, whose mutual distance R has been divided into the two apparent radii $\xi \bar{\rho}_1$ and $\xi \bar{\rho}_2$, is expressed in the form $F(\xi)/R = \phi(\xi)/(\bar{\rho}_1 + \bar{\rho}_2)$ where $F(\xi)$ is a function rapidly falling with increasing ξ. An analytical expression is found empirically for the function $\phi(\xi)$. G. G. S.

2801. Quantum Mechanics and Sophus Lie's Theory of Finite and Continuous Groups. J. Mariani. *Comptes Rendus,* 196. *pp.* 900–902, *March* 27, 1933.—Points out and emphasises the importance of the Lie theory in quantum mechanics, for from it the Schrödinger expressions can be derived. A. D.

2802. Quantum Mechanics of Diatomic Systems. M. Born and S. Flügge. *Ann. d. Physik,* 16. 7. *pp.* 768–780, *April,* 1933.—Taking account of the fact [see Abstract 2432 (1930)] that for quantisation of the asymmetric top the exchange relations for the components of the moment of momentum referred to the principal axes of the inertia ellipsoid are identical with those referred to fixed axes, the problem of the motion of two atoms is solved. The atoms may be bound together to form a molecule or may be in a state of collision. Account is taken of the effect of the electron motion on the motion of the nuclei, but electron spin is neglected. G. G. S.

2803. Schrödinger's Wave Equation. G. D. Birkhoff. *Nat. Acad. Sci., Proc.* 19. *pp.* 339–344, *March,* 1933.—It is shown that the wave equation is the simplest form of linear partial differential equation involving a parameter, for which the classical process determining asymptotic series solutions gives a " multiplier equation " identical with the Hamilton-Jacobi equation, while the Cauchy characteristics of the multiplier equation along which the asymptotic " wave packet " is always propagated then become the dynamical trajectories of the corresponding Hamiltonian system. **Errata,** *ibid. p.* 475, *April,* 1933. N. M. B.

2804. Probability of the Presence of the Electron According to Wave Mechanics. U. Crudeli. *N. Cimento,* 10. *pp.* 52–56, *Feb.,* 1933.—In the case of an electron moving in an assigned electromagnetic field, treated from the point of view of wave-mechanics, a comprehensive formula for the probability density is obtained which satisfies the well-known equation of continuity of a fluid. A. J. McC.

See also Abstracts 2673, 2780, 2783, 2926, 3019, 3158.

RELATIVITY AND ETHER.

2805. First Twenty-Five Years of Relativity. R. Marcolongo. *Elettrotecnica,* 20. *pp.* 201–204, *March* 25, *and pp.* 223–228, *April* 5, 1933.—Gives a brief summary of the various theories of relativity that have been proposed from 1905 to the present day, including the special theory, the general theory and the different unitary theories of the last few years. A. J. McC.

2806. Non-Static Riemannian Manifolds with Axial Symmetry. J. Delsarte. *Comptes Rendus,* 196. *pp.* 888–889, *March* 27, 1933.—It is shown what mathematical assumptions can be used to obtain the metric of non-static manifolds with axial symmetry by means of Einstein's equations. Only particular solutions can be obtained by the method.

G. C. McV.

2807. Riemann's Homography Relative to a Curved Space. T. Boggio. *Accad. Lincei, Atti,* 17. *pp.* 368–374, *March* 5, 1933.—A new method, using vector notation only, of introducing the Riemann-Christoffel symbols of a curved space and of demonstrating their fundamental properties.

A. J. McC.

2808. Mechanical Interpretation of Levi-Civita's Parallelism. M. Haimovici. *Accad. Lincei, Atti,* 17. *pp.* 541–546, *April* 2, 1933.—In addition to the known geometrical and kinematical interpretations of this parallelism, the author, studying the equations of motion under certain simplifying assumptions, deduces a mechanical interpretation.

A. D.

2809. Theory of the Bending of Light Rays by the Sun. E. Freundlich and A. v. Brunn. *Zeits. f. Astrophysik,* 6. 3. *pp.* 218–235, *April* 8, 1933.—A discussion is given of the theoretical methods of determining the bending of light rays passing close to the sun during a total eclipse. It is demonstrated that it is imposible to determine the deflection from photographs obtained by the astrograph in the Potsdam eclipse expedition to Sumatra on May 9, 1929. This is due to the fact that there is no means of determining *à priori* the scale-correction of the plates or of disentangling the effect of this correction from that of the true deflection. The photographs obtained by the horizontal camera method, however, do give the scale-correction independently. The latter is determined by photographing the same network of lines on the plate carrying the stars near the sun as well as on the plate of the comparison field. A recalculation of the deflection, using this method, still gives the value $2''\cdot 2$ obtained at the first reduction.

G. C. McV.

2810. Definition of Distance in General Relativity. I. M. H. Etherington. *Phil. Mag.* 15. *pp.* 761–773, *April,* 1933.—Considers the problem of defining, in a general Riemannian space-time, the concept of distance between two particles, as distinct from that of interval or integrated line-element between two events. In connection with E. T. Whittaker's project to estimate the distances of stars and galaxies from their brightness he shows that such distances will agree exactly with the distance computed from the estimated size only when the star has no apparent angular velocity. For spherical objects of the same absolute size and brightness, moving variously at varying distance from the observer, the ratio of the apparent diameter to the square root of the apparent brightness is proportional to $(1 + S\lambda/\lambda)$ instead of being constant, as is ordinarily assumed. This might be made the subject of an additional test.

E. E. F. d'A.

2811. Geometry of Two-Component Spinors. O. Veblen. *Nat. Acad. Sci., Proc.* 19. *pp.* 462–474, *April,* 1933.—This paper, a geometric commentary on a paper by Weyl [see Abstract 3493 (1929)] discusses the generalisation of Dirac's equations to general relativity theory in the simplest case, *viz.,* that treated by direct generalisation of the spinors defined by van der Waerden [Spinoranalyse, Göttingen Nachrichten, 100, 1929].

J. S. G. T.

2812. Straneo's Unitary Theory. A. de M. Fernandes. *Accad. Lincei, Atti*, 17. *pp.* 227–230, *Feb.* 5, 1933.—Works out certain conclusions confirming Straneo's theory, and extends its range of applicability. A. D.

2813. Space-Time in the Unitary Field Theory. J. A. Schouten. *Zeits. f. Physik*, 81. 5–6. *pp.* 405–417, *March* 22, 1933.—From the point of view of ordinary relativity, there are two invariant planes in spin space. We need, therefore, only admit transformations which leave these planes invariant. In projective relativity [see Abstract 104 (1933)] these two planes do not lose their invariance, but they are no longer constantly covariant, and we must therefore adopt general linear transformations in the spin space. In the present paper the author shows how the spin space is connected with the local space-time world, what invariant structures exist in spin space, and how an invariant calculus may be constructed. E. E. F. d'A.

2814. Projective Relativity and the Einstein-Mayer Unified Field Theory. B. Hoffmann. *Phys. Rev.* 43. *pp.* 615–619, *April* 15, 1933.—The relationship between the Einstein-Mayer unified field theory and the projective relativity theory is developed and it is shown that the field equations (47) of the former theory may be interpreted as conditions that the connection employed be reducible to a symmetric form by means of a suitable non-holonomic factor change. Grounds are found for questioning an assumption made by Schouten and van Danzig. [See Abstract 104 (1933).] AUTHOR.

2815. Connection between Field and Matter. R. Zaycoff. *Zeits. f. Physik*, 82. 3–4. *pp.* 267–278, *April* 29, 1933.—A five-dimensional vector-field related to each point of a four-dimensional Riemannian manifold has been used by Einstein to establish a unified field theory of electricity and gravitation. It is now shown that a formal representation of Dirac's wave equations can be made by the use of this vector-field. The desired field-equations are obtained by the variation of the integrals of suitably chosen functions. G. C. McV.

2816. Relativity Cosmogony. Part II. R. Zaycoff. *Zeits. f. Astrophysik*, 6. 3. *pp.* 193–197, *April* 8, 1933.—A mathematical paper in which the author puts the geometry of the non-static universe in a symmetrical form which enables the energy density of a homogeneous distribution of atoms and radiation quanta to be computed, whereby a basis is obtained for the covariant form of wave mechanics. A world-model allowing for annihilation of matter and energy is set up, which appears to render possible some discussion of the development of the contents of the universe. [See Abstract 1759 (1933).] T. L. M.

2817. Spherical Condensations in the Expanding Universe. G. Lemaitre. *Comptes Rendus*, 196. *pp.* 903–904, *March* 27, 1933.—The mathematical theory is given of universes in which there is a concentration of matter around a point. Special attention is devoted to the physical interpretation of the coordinates used. G. C. McV.

2818. Formation of Nebulæ in the Expanding Universe. G. Lemaitre. *Comptes Rendus*, 196. *pp.* 1085–1087, *April* 10, 1933.—The physical interpretation is given of certain mathematical results, respecting the formation of condensations in an expanding universe, already found [see preceding Abstract]. The condensation can be shown to affect only a certain spherical region of space, outside which the expansion goes on uninfluenced by the presence of the condensation. Within the region, the matter expands for a time, then collapses on to the condensation at the centre. It is possible to show that the radius of the affected region around a condensation in a spherical universe is of the order of that of the Virgo cluster of nebulæ. G. C. McV.

2819. Mass-Particle in an Expanding Universe. G. C. McVittie. *Roy. Astron. Soc., M.N.* 93. *pp.* 325–339, *March*, 1933.—The solution of Einstein's equations corresponding to the Schwarzschild solution for a mass-particle is given when the matter in the universe outside the mass-particle is supposed to be spread out evenly as if it were a gas and when distant objects exhibit the recession phenomenon. The solution follows from two postulates: (*a*) that the matter outside the mass-particle has an isotropic pressure, and (*b*) that it is not flowing towards or away from the mass-particle. The orbits of planets are worked out and it is shown that, if the system of the nebulæ be considered to be at rest, the orbits of the planets continually appear to shrink in size whilst the mass of the central particle continually decreases. If, however, coordinates are chosen such that the planetary orbits are of constant size and the central particle has constant mass, then the system of the nebulæ appears to expand. Various related questions are also discussed. G. C. McV.

2820. Milne's Theory of the Expansion of the Universe. G. C. McVittie. *Nature*, 131. *pp.* 533–534, *April* 15, 1933.—A summary of E. A. Milne's kinematical theory of the phenomenon of the recession of the nebulæ [see Abstract 1347 (1933)]. G. C. McV.

2821. World Structure and the Expansion of the Universe. E. A. Milne. *Zeits. f. Astrophysik*, 6. 3. *p.* 244, *April* 8, 1933.—The author points out that the equations involved in his kinematical theory of the expansion of the nebulæ [see Abstract 1347 (1933)] do permit of the motions of the nebulæ being along other than straight lines. Thus his theory can account for gravitational attraction between the nebulæ. G. C. McV.

2822. Eddington's Problem of the Expansion of the Universe by Condensation. N. R. Sen. *Roy. Soc., Proc.* 140. *pp.* 269–276, *May* 3, 1933.—In an Einstein universe it is imagined that the matter within a spherical region of radius r_1 condenses into a concentric spherical mass of radius r_2 $(< r_1)$, so that the region between the spheres of radii r_2 and r_1 is a vacuum. It can then be shown, by fitting together the metrics corresponding to these three regions, that, if the Einstein universe outside the sphere r_1, is to remain unchanged during this process, there must be more mass within the condensation of radius r_2 than was contained inside r_1 before the process of condensation began. Since mass cannot be created, this defect of mass inside the region of condensation will cause the universe outside the sphere r_1 to begin expanding. It is demonstrated that this is a second order effect. Thus the formation of condensations will start an expansion of the Einstein universe. The method, however, does not take into account possible compensating factors, *e.g.*, changes in pressure, which may accompany the formation of the condensations. G. C. McV.

2823. Atomistic Conception of Space and Time. L. Schames. *Zeits. f. Physik*, 81. 3–4. *pp.* 270–282, *March* 11, 1933.—The author assumes indivisible quanta of length and time, l_0 and t_0 respectively, and takes the mass m_0 of the hydrogen atom (or of the neutron) as the quantum of mass. For the velocity of light c and Planck's constant h, he then obtains $c = l_0/t_0$, $h = l_0 m_0 c$, and derives $l_0 = 1 \cdot 32 \times 10^{-13}$ cm. and $t_0 = 4 \cdot 40 \times 10^{-24}$ sec. l_0 is identified with the nuclear radius and the electron radius. The dynamics of the rotating electron are discussed and a magnetic moment for the free electron is derived which is much smaller than the Bohr or Weiss magneton. The Weiss magneton appears to be more simply related to l_0 and t_0 than the Bohr magneton. A fundamental distinction is drawn between material and electromagnetic mass with special reference to the formation of the hydrogen atom and the neutron. W. S. S.

See also Abstracts 2953, 3115.

SOLUTION.

2824. Rate of Solution of Oxygen in Ethyl Alcohol Solutions of Stannous Chloride. S. Miyamoto and E. Utunomiya. *Hiroshima Journ. Sci.* 3. *pp.* 193–208, *March*, 1933. *In English.*—The rates of solution of oxygen in ethyl alcohol solutions of stannous chloride of various concentrations support Miyamoto's theory rather than the diffusion layer theory. u_0 at 23·9 – 26° is nearly constant, and = 1·495 – 1·516, average 1·501. [See Abstract 896 (1933).] C. A. S.

2825. Solubility of Silver in Mercury. R. E. DeRight. *J. Phys. Chem.* 37. *pp.* 405–416, *April*, 1933.—Solutions of silver in mercury were prepared by heating the two metals together in vacuo. The amalgams were analysed by distilling off the mercury in a current of hydrogen. Amalgams as dilute as 0·06 % atomic were analysed in this way with an accuracy of one part per thousand. The solubility of silver in mercury was determined over the temperature range of 20° to 80° C. In this range of temperature the solubility changes according to the equation $\log N = -1105 \cdot 8/T + 0 \cdot 5894$. F. J. B.

2826. Are Liquid Sodium Amalgams Colloidal ? H. E. Bent. *J. Phys. Chem.* 37. *pp.* 431–436, *April*, 1933.—Liquid sodium amalgams are not colloidal as suggested [see Abstract 22 (1933)]. The properties on which the suggestion was based are equally well explained on other grounds. The composition of the solid amalgam is uniform. The freezing point depression and the lowering of vapour pressure are those of true atomic dispersion. A. S. C. L.

See also Abstracts 2665, 2938, 3085, 3089, 3198, 3199, 3200, 3201.

SURFACE TENSION AND COHESION.

2827. Automatic Recording of Setting Time of Cement. N. Davey. *Journ. Sci. Instruments*, 10. *pp.* 148–150, *May*, 1933.—A description is given of an apparatus which allows an automatic record of the progress of setting of a cement to be made. The apparatus incorporates the essential details of the standard Vicat needle with the additional advantages that the needle is cleaned automatically each time it has penetrated the cement, and that the time interval between each penetration may be varied to suit different types of cement (*viz.*, slow setting and quick setting). The apparatus has also been designed for use on small experimental samples of cement. AUTHOR.

2828. Simple Derivations of Some Important Relationships in Capillary Flow. R. K. Schofield. *Physics*, 4. *pp.* 122–128, *March*, 1933.—Geometrical constructions are employed to demonstrate the conditions under which a unique curve is obtained by plotting $V/\pi R^3$

against $\frac{1}{2}p$R which is independent of the value of R. Account is taken of the discrepancies due to modified flow near the wall of the tube. The velocity gradient at the wall of the tube is deduced from experimental figures for V, p and R. The deductions, though simple, are still of general applicability. F. J. B.

See also Abstracts 2667, 2670, 2671, 2672, 2718, 2890.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 2785.

VACUA, HIGH.

2829. Pumps. G. Mönch. *Phys. Zeits.* 34. *pp.* 303–304, *April* 1, 1933.—Description of apparatus for demonstrating the pumping action of water-jet, mercury-vapour-jet and diffusion-pumps. A. D.

See also Abstract 3119.

VISCOSITY, FRICTION AND LUBRICATION.

2830. Viscosity of Gases and Other Problems of Kinetic Theory. N. Gerasimov. *Phys. Zeits.* 34. *pp.* 387–388, *May* 1, 1933.—Investigates the velocity distribution of the molecules in a mixture of two gases, and a formula for viscosity when the molecules are not assumed to be solid elastic spheres. J. H. A.

2831. Viscosities of Acetaldehyde and Paraldehyde. W. H. Hatcher and C. T. Mason. *Canad. J. of Research,* 8. *pp.* 402–403, *April,* 1933.—The viscosities of acetaldehyde, of paraldehyde and of mixtures of these are given at 15° C., using materials freshly distilled out of contact with oxygen. AUTHORS.

2832. Internal Friction in Coarse Disperse Systems. B. Iliin, T. Massillon and N. Zacharoff. *Kolloid. Zeits.* 63. *pp.* 27–34, *April,* 1933.—A paste, for example, of chalk and water is placed between two incomplete coaxial cylindrical surfaces, one of which is fixed, and the other attached to a pendulum. From the damping of the oscillations of the pendulum, information concerning the internal friction of the paste, and its variation with concentration, size of grain, etc., is obtained. Mixtures of three components are also investigated. J. P. A.

2833. Influence of Slip on Viscosity of Suspensions. R. Eisenschitz. *Phys. Zeits.* 34. *pp.* 411–415, *May* 15, 1933.—The apparent viscosity of a liquid containing small ellipsoids in suspension depends on the ratio of the axes of the particles, and it has been proposed to deduce the shape of the particles from experimental results. The paper points out that for particles of the size met with in colloidal suspensions, slip will be appreciable, so that the previous theories do not hold. Calculates the apparent viscosity, and finds that for a given shape it varies so much with the slip coefficient that the shape could not be deduced in the way above outlined. J. H. A.

2834. Viscosities of Air, Argon and Hydrogen Chloride and their Dependence on Temperature. J. R. Partington. *Phys. Zeits.* 34. *pp.* 289–292, *April* 1, 1933.—Measurements by Williams, Shilling and Laxton and others under the author's direction, using a spiral capillary, are re-discussed, and new results obtained by Anfilogoff are described. No set of determinations agrees exactly with Sutherland's law $k\eta = T^{3/2}/(T + C)$ where η is the viscosity, T the absolute temperature and k, C are constants. The deviations are ascribed to a type of flow (" bent tube flow ") differing from streamline flow. It sets in at low temperature, when in fact log $vd^{3/2}\rho/\eta D^{\frac{1}{2}}$ is less than 0·95. Here v is the mean linear velocity, d the bore of the tube, ρ the density, η the viscosity and D the diameter of the spiral on which the capillary is wound. Sutherland's law is true for the three gases air, argon and HCl, from room-temperature up to about 750° C., the constants being as below :

Gas.	$K \times 10^{-5}$	*C.*
Air	1·4821	117·9
Argon	2·0074	162·7
HCl	1·9012	387·3

J. H. A.

2835. Viscosity of Gases at High Temperatures. P. Brémond. *Comptes Rendus,* 196. *pp.* 1472–1474, *May* 15, 1933.—The coefficients of viscosity of air and carbon dioxide have been experimentally determined by a method depending on Poiseuille's law for temperatures 0–1134°. The results agree within 1·4 % with those deduced from Breitenbach's values of Sutherland's constant. C. A. S.

2836. Beneficial Effect of Oxidation on the Lubricating Properties of Oil. R. O. King. *Roy. Soc., Proc.* 189. *pp.* 447–459, *Feb.* 1, 1933.—The experiments now described were made under conditions promoting oxidation of the lubricating oil and at constant speed and load. Friction falls as the temperature is raised and generally passes through a minimum value (μ min.) at a temperature somewhat less than that of seizure (S.T.) ; for a typical blended oil at the beginning of oxidation μ and S.T. were 0·0010 and 158° C. respectively. Viscosity increased with oxidation, but the consequent increase of fluid friction was apparent below 50° only, *i.e.,* when the fluid film was relatively thick. Friction at higher temperatures decreased with the progress of oxidation and S.T. rose. The oil in a state of partial combustion remained an effective lubricant, μ being less than ever recorded for fluid friction, even with air as the lubricant. A safe region of high temperature lubrication was attained, and experiments with various oils show that the extent of this region and the life of the oil depend on oxidation characteristics ; friction is due neither to viscosity nor to the action of the adsorbed layer. It is suggested that the active or polar molecules formed during the early stage of oxidation build up to an appreciable thickness on the adsorbed layer, and the friction observed is that on the surface of the built-up layer. The surface diminishes in rigidity in the direction of motion as the thickness of the boundary layer increases, and friction approaches zero as a surface of complete slip tends to be reached. H. H. Ho.

2837. Friction in Sands. G. I. Pokrowski. *Kolloid Zeits.* 63. *pp.* 25–27, *April,* 1933.—The force of friction between particles in a mass of sand is not constant, but is given by a probability distribution. As a theoretical consequence, the measured coefficient of friction should increase with increasing size of particles more rapidly than previously anticipated. An experiment in verification is described. J. P. A.

2838. Kinematic Viscosities and Times of Outflow of Commercial Viscometers. F. H. Garner and C. I. Kelly. *Physics,* 4. *pp.* 97–112, *March,* 1933.—A discussion of methods of standardisation of commercial viscometers. A. S. C. L.

See also Abstracts 2687, 2761, 2762, 3079, 3080.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

2839. Trial of a Projection Method for Measuring Photographs. F. Schlesinger and A. L. Bennett. *Roy. Astron. Soc., M.N.* 93. *pp.* 382–389, *March*, 1933.—A description of an instrument for measuring stellar photographs by projecting them on to a screen with a magnification of some twenty-five to thirty times. The fatigue accompanying the use of this method is much less than that involved in the use of the usual method. A test of the accuracy of the projection method was made by measuring 172 parallax plates twice, once by the ordinary method and then by projection. The results obtained by the two methods were in very good agreement. G. C. McV.

2840. Construction of a Telescope Mirror of 1·20 m. Diameter. A. Couder. *Bull. Astronomique*, 7. 10. *pp.* 423–433, 1932.—The details of a mirror constructed in 1875 are given and the method of renovation outlined. Tests on the mirror, including a modified Foucault knife-edge test and a Hartmann test, are described and discussed. The possibility of correcting the spherical aberration, if not too great, by mounting the mirror so as to introduce a mechanical deformation in the appropriate direction, is investigated. W. D. W.

2841. Astrometry with Mirrors and Lenses. F. E. Ross. *Mt. Wilson Observat. Contrib. No.* 467. *Astrophys. J.* 77. *pp.* 243–269, *May*, 1933.—As part of the development work for the proposed 200-in. reflecting telescope of the California Institute of Technology, a lens has been designed by the writer to be placed near the focus of the mirror with the object of correcting the large outstanding aberration of coma, which is serious in a mirror of the high speed ratio proposed. A trial lens was made and applied to the Mount Wilson 60-in. telescope. The present paper deals primarily with the astrometric characteristics of the correcting lens and mirror system, as compared with those of the usual mirror systems, and also gives a comparative study of all the telescopes available, ten in all. AUTHOR.

2842. Photoelectric Methods in Astrophotometry. F. Löhle. *Zeits. f. Astrophysik*, 6. *pp.* 293–304, *May* 11, 1933.—Experiments have been made to test the value of the caesium photoelectric cell for quantitative measures in astronomy. It is sensitive to a very much longer region of spectrum than eye or photographic plate, but there are such serious technical difficulties in using it for astronomical work that it cannot with present means yield good results. M. A. E.

COMETS AND METEORS.

2843. Spectrum of Comet 1911 V (Brooks) on Moscow Observatory Spectrograms. S. Vsessviatsky. *Zeits. f. Astrophysik*, 6. *pp.* 305–312, *May* 11, 1933. *In English.*—Between Aug. 20 and Nov. 3, 1911, seventeen spectrograms were got, and have been investigated by means of the Krüss self-registering micrometer for qualitative spectrum changes of the comet. The method of obtaining the microphotometer tracings is described. A table is given of the wave-lengths of separate crests on the microphotograms, their intensities being relative to λ3883. A variability of the continuous spectrum with time is undoubted; in August the maximum brightness was at λ4000, in October–November at λ4600. Changes took place both in the general brightness of separate bands, and also of the separate components of the bands; with approach to the sun, λ3871 became systematically fainter as compared with λ3883. With approach to perihelion the maximum of brightness in the Raffety system was displaced to the violet, and the system weakened with respect to λ3883; there is corroboration that the Raffety group is akin to hydrocarbon radiation. On the contrary, CN_{III} and CN_{II} increased in relative intensity with approach to the sun, and their rate and increase of absolute brightness is more than for CN_{IV}, and the maximum intensity shifts to the red. Towards the comet's tail, CN_{IV} got rapidly fainter; the limit of expansion of cyanogen radiation was (in Comet V, 1911) 0·002–0·004 astronomic units from the nucleus; after this the normal tail spectrum, of CO^+, was observed. Cyanogen, therefore, spreads into the tail to some extent, but the hydrocarbon radiations do not pass the limits of the head. A. S. D. M.

2844. Penetration of Iron Meteorites into the Ground. W. J. Fisher. *Nat. Acad. Sci., Proc.* 19. *pp.* 286–291, *March*, 1933.—The observed penetration of the ground by iron meteorites is tabulated and compared with ballistic theory. For the smaller objects the cosmic velocity does not enter, and penetration for the same soil is related to the cube root of the mass; for large meteors the cosmic velocity does enter. The data for stony meteorites are numerous but unpromising owing to wide scatter; being usually small and specifically lighter they are affected by the nature of the top soil. T. L. M.

COSMOGONY.

See Abstract 2816.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2845. Internal Rotation of a Heterogeneous Fluid Ring. P. Dive. *Bull. Astronomique*, 7. 10. *pp.* 435–448, 1932.—The paper is an attempt to justify a fluid hypothesis for such a structure as Saturn's ring, generalising by introducing heterogeneity and the possibility of a relative movement of particles; the fluid is considered as in layers of constant density in the form of tores of concentric circular meridian section, the density decreasing continuously outwards. The author applies his general mathematical theory of internal rotations in fluid bodies to show that his hypotheses lead to a permanent system of rotations capable of maintaining the fluid ring. The discussion of the stability of the motions analysed is not undertaken. T. L. M.

See also Abstracts 2774, 2775.

LATITUDE AND LONGITUDE.

2846. Effect of a Theoretical Tidal Variation of the Zenith on the Annual Variation of Latitude. J. C. Dobbie. *Roy. Astron. Soc., M.N.* 93. *pp.* 377–382, *March*, 1933.—A theoretical calculation of the tidal oscillation of the vertical is given, using the Greenwich observations for the years 1919–1927 made for the purpose of determining the annual variation of latitude. The contribution to this effect of the ocean tide is alone of importance. It is shown that the greatest deflection of the vertical is of the order of 0″·01. G. C. McV.

See also Abstract 2889.

NEBULÆ.

2847. Colours of Diffuse Nebulæ having Continuous Spectra. O. Struve, C. T. Elvey and P. C. Keenan. *Astrophys. J.* 77. *pp.* 274–282, *May*, 1933.—Theoretical results indicate that if a nebula emitting a continuous spectrum consists of free atoms or molecules or of particles smaller than $\frac{1}{4}\lambda$, the colour of the nebula must be appreciably bluer than that of the exciting star. The difference, star-nebula, at λ 3900 and λ 5000 is by theory + 1·1 mag. Spectrographic observations of the nebula in the Pleiades give + 0·3 mag. The difference, star-nebula, at λ 4250 and λ 4750 (the effective wave-lengths of the Yerkes photoelectric photometer) is by theory + 0·5 mag. Actual observations with a potassium cell and two light-filters give $+ 0\cdot1 \pm 0\cdot05$ mag. It is suggested that the nebula consists of a mixture of large and small particles, most of the reflected light coming from the larger particles, which scatter without relation to λ. AUTHORS.

2848. Surface Brightnesses of Elliptical Nebulæ. P. C. Keenan. *Astrophys. J.* 77. *pp.* 283–290, *May*, 1933.—Mean surface brightnesses were computed for elliptical nebulæ from the dimensions and total magnitudes given in the catalogue of Shapley and Miss Ames. The apparent increase in surface brightness with diminishing area can be attributed in part to the Hubble effect for threshold images, and in part to a systematic trend in the computed areas. The magnitude scale shows no evidence of large systematic variations. AUTHOR.

2849. Distribution of Galaxies. H. Shapley. *Nat. Acad. Sci., Proc.* 19. *pp.* 389–393, *April*, 1933.—Preliminary results of the Harvard survey of faint external nebulæ are presented, covering over 300 regions of 9 square degrees each. The distribution of external galaxies is presented, showing concentration to galactic poles, greater concentration in N. hemisphere (where the distribution is steady from 20° N. gal. lat.), effect of dark streamers south of 20° S. gal. lat., and such large average deviations as to show conspicuous non-uniformity of distribution from field to field. Some causes of slight uncertainty in the limiting magnitude reached are fully discussed. T. L. M.

See also Abstracts 2817, 2818, 2819, 2820, 2821, 2860.

PLANETS.

2850. Surface Brightness of Illuminated Spheres. C. Wirtz. *Zeits. f. Astrophysik*, 6. *pp.* 236–240, *April* 8, 1933.—A continuation of a paper [see Abstract 4858 (1932)] showing that photometric measurements of surface-brightness of the planets can be reproduced in a laboratory by measuring the surface-brightness of a sphere of white chalk. Quantitative details are here given of these measurements. G. C. McV.

See also Abstracts 2746, 2845, 2877.

STARS.

2851. Space Motions of Stars in Orion and Scorpio-Centaurus Clusters. F. D. Miller. *Nat. Acad. Sci., Proc.* 19. *pp.* 277–286, *March*, 1933.—The paper is a discussion of rectangular components of space motion, corrected for solar motion and freed of systematic error for 166 B-stars in the Scorpio-Centaurus region and 57 in Orion region. The procedure resembles that of Kapteyn's earlier streaming discussion. Some remarks on the errors of the observed quantities are given; a difficulty is introduced into the theoretical velocity distribution by the fact that both radial and cross motions enter with their differing sources of error. The observed velocity distributions are shown both corrected and uncorrected for K-term. Comparison with theory suggests that the Orion stars mainly form a homogeneous cluster; the convergent is found, R.A. 6h. 11m., dec.–13°, vel. 22·7 km./sec. The Sco-Cen distribution presents secondary maxima; the curves are compared with theory and previous work; tests for the reality of the secondary maxima, depending on the inclusion of higher velocities, are applied. Kapteyn's conclusion that the mean true peculiar motions were very small is confirmed; they are certainly under 2 km./sec. The author regards the motions as explained by the two moving clusters, without introducing the general star streams. T. L. M.

2852. Star Streams in Ursa Major. A. Bemporad. *Accad. Lincei, Atti,* 17. *pp.* 497–502, *April* 2, 1933.—In a research on proper motions, based on a comparison between the Astrographic Catalogue of Catania and that of Yale IV, where the epoch differs by about a dozen years, systematic streaming in different directions has been detected. On 8 plates which cover a field of about 14 square degrees, out of 136 stars only 19 were found having a proper motion greater than 0″·100. Five streams are clearly distinguished, and shown on a diagram. M. A. E.

2853. Variable Spectrum of γ Cassiopeiæ. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 93. *pp.* 362–373, *March,* 1933.—The spectrum is unusually interesting, Bo with bright metallic lines, nebulous lines, and bright H lines; but has been thought constant. Sixty-eight photographs taken at Norman Lockyer Obs. show marked changes, indicated by the variations in the relative intensity of the bright components of the H lines; these changes may be periodic, period about 4 years; some radial velocity measures suggest variation and are consistent with similar periodicity. T. L. M.

2854. Character of Spectral Lines and Stellar Rotation. G. Shajn. *Zeits. f. Astrophysik,* 6. *pp.* 176–192, *April* 8, 1933.—Among stars of O, B, A and early F types, very broad and diffuse lines are frequently found, but they are rare in stars of later types. And among spectroscopic doubles of the same early types, the shorter the period the greater the frequency of this kind of line. If, as demonstrated, this character almost certainly denotes rapid rotation, then a large number of single early-type stars are now in a state bordering on instability, and many spectroscopic doubles have just passed through it. M. A. E.

2855. Absorption Lines of N V in Stella Spectra. Cecilia H. Payne. *Astrophys. J.* 77. *pp.* 299–300, *May,* 1933.—The lines of four-times ionised nitrogen require greater excitation than any others hitherto identified in stellar spectra. They have been observed, as absorption lines, in several Wolf-Rayet stars. AUTHOR.

2856. Greenwich Star Temperature Scale. A. Brill. *Zeits. f. Astrophysik,* 6. *pp.* 203–206, *April* 8, 1933.—The author finds no convincing reason for applying an extinction correction to the zero of the Greenwich Observatory star temperature scale, such as proposed by H. Kienle. [See also Abstract 1913 (1932).] T. L. M.

2857. Effects of Changes in Stellar Temperatures and Absolute Magnitudes. W. W. Morgan. *Astrophys. J.* 77. *pp.* 291–298, *May*, 1933.—The behaviour of some of the more abundant metals is traced through a representative temperature series of giants and dwarfs. Mg II, Fe II, Cr II, and Ti II show " null effects " on the high-temperature side of their maxima. In the case of Mg II there is a null effect from O9 through B5, for Fe II and Cr II at B8, and for Ti II at A0 and A2. There is a pronounced absolute-magnitude effect for all four elements on passing to lower temperatures. In the dwarfs the maximum for Mg II, Fe II, and Cr II is at A0–A2. The maximum is sharper for Mg II than for Fe II or Cr II. In the case of Ti II the lines in the dwarf sequence remain sensibly unchanged in intensity from A2 through K5. In the giants the maximum for Mg II is between A2 and F5 while for Fe II, Cr II, and Ti II it is at F5. Ba II shows no null effect corresponding to the other elements; it is weakened in giants up to between F5 and F8, after which it is strengthened. Sr II and Fe I behave like Ba II. The relative numbers of atoms contributing to line intensities in giants and dwarfs are found by means of the Russell-Adams calibration of the Rowland intensity scale. At spectral type F5, where the maximum absolute-magnitude effect takes place for Mg II, Fe II, Cr II, and Ti II, there are around twenty times as many atoms contributing to the lines of each of these elements in supergiants as in dwarfs. AUTHORS.

2858. Upper Limits of Density and Temperature in a Star (Second Paper). A. S. Eddington. *Roy. Astron. Soc., M.N.* 93. *pp.* 320–324, *March*, 1933.—The paper is concerned with the determination of upper limits for the density and temperature of stars which have central regions consisting of matter in a state of ordinary or of relativistic degeneracy. The method only gives limits for stars of small mass, *e.g.*, if the molecular weight is 2, the greatest mass which can be dealt with is $0{\cdot}436 \times \odot$. In such stars it is shown that the upper limit of the density is of order $8{\cdot}7 \times 10^6$ gm./cm.^{3} and, of the temperature, $1{\cdot}8 \times 10^9$°C. The conclusion is that very high temperatures are not necessary for the abundant liberation of sub-atomic energy. [See Abstract 2627 (1931).] G. C. McV.

2859. Equilibrium of Distorted Polytropes. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 93. *pp.* 390–405, *March*, 1933.—A mass of gas at rest has its distribution of density and pressure determined by a solution (without central singularity) of Emden's equation of index n. The problem to be solved is to determine the shape and density distribution of this gas sphere if it is started rotating with a small constant angular velocity. It is shown that the problem can be solved when the rotation is so slow that the fourth power of the angular velocity can be neglected, provided the Emden function for the configuration at rest is known. Numerical calculations of the equations involved, for the cases corresponding to the Emden functions for $n = 1, 1{\cdot}5, 2, 3$ and 4, are given. It follows, from the general theory, that for a given angular velocity, the fractional elongation of the model at the equator increases much more rapidly than the fractional contraction at the poles, as the central condensation of the model increases. The comparison of models of equal mass, one at rest, the other rotating, brings out clearly the peculiar character of the configuration governed by Emden's equation of index 3. G. C. McV.

2860. Problems of Diffuse Matter in the Galaxy. J. S. Plaskett and J. A. Pearce. *Dominion Astrophys. Obs., Victoria, Publ.* 5. 3. *pp.* 167–237, 1933.—The authors divide the problems into 8 sections, giving for the diffuse matter results: (1) its probable values of density and temperature are 10^{-25} gm./cm.^{3}, and 15,000° T; (2) confirmation of the rotational swing in both stellar and inter-stellar velocities and that stellar $\bar{r}A$ is almost exactly twice diffuse matter $\bar{r}A$, indicating that diffuse matter is uniformly distributed; (3) complete data of 3,332 measures by 46 observers of 3,038 spectra of 314 stars, with their probable error; (4) reasons for omitting the K term because of the limited distribution of stars; without it the rotational terms correspond to the centres of gravity distance, and gives (on the average) 310 and 650 parsecs respectively for diffuse matter and stars, and points to homogeneous distribution and motions for both; (5) the relation between intensity (I) and $\bar{r}A$ or distance of diffuse matter indicates that these increase together, $\{\bar{r}A = 2 \cdot 20 (I - 1 \cdot 51)\}$, affording a method of determining the distance of individual stars, and of checking the correctness of the intensity scale, and the uniformity of distribution of diffuse matter; (6) the mean parallaxes of 226 stars are used for determining the value of the constant A (0·0166 km/sec. per parsec. in the mean); (7) from 249 stars there is found the ratio of $\bar{r}A$ or distance for stars and diffuse matter, giving the $\bar{r}A$ of the stars as about double that of the diffuse matter, corroborating the uniform distribution of this; (8) gives a case of a massive B9 binary which shows in certain phases of the orbit both stellar and inter-stellar lines, thus removing a difficulty in Eddington's theory. A catalogue is given of stars showing inter-stellar lines. A. S. D. M.

2861. Space Distribution of Stars in Two Fields. F. Becker. *Zeits. f. Astrophysik*, 6. *pp.* 198–202, *April* 8, 1933.—The author continues his discussion of the distribution of stars by spectrum type and magnitude [see Abstracts 513 and 517 (1933)]. Two fields in the Crux-Carina region, nos. 193, 194, give similar results to previously investigated galactic fields, for the size and structure of the local star system; there are large local variations of star density as far as 600–700 parsecs, after that a falling off. There is some evidence of a dense star-cloud at about 250 parsecs, and one less dense at 700. The whole system is analogous to that of Pannekoek. T. L. M.

2862. Space Distribution of Globular Clusters. P. van de Kamp. *Astron. J. No.* 989. *pp.* 161–164, *May* 5, 1933.—The apparent distribution of globular clusters shows a marked avoidance of low galactic latitudes and a considerable elongation in the general direction of the distant centre of the system. But if it is assumed that there is a galactic absorbing layer symmetrical with the galactic plane, and of uniform optical thickness equal to 0·8 photographic magnitude, and if the apparent distances are corrected on this hypothesis, it then appears that the globular clusters show a fair degree of spherical symmetry in their distribution round the centre of their system, and are highly concentrated towards this centre, but by reason of the absorption many clusters close to the galactic plane have probably escaped detection. M. A. E.

2863. Irregularities of Period of S Bootis and R Camelopardalis. S. Plakidis. *Roy. Astron. Soc., M.N.* 93. *pp.* 373–376, *March*, 1933.—The author applies his method [see Abstract 3668 (1932)] to two stars for which W. F. H. Waterfield was unable to formulate periodicity in the change of period or phase, although periodograms suggested such an effect. The author concludes that the whole irregularity of both stars consists rather of a purely accidental fluctuation of period combined with a purely accidental fluctuation of phase. T. L. M.

2864. Cepheid "Lag." G. Tiercy. *Arch. des Sciences,* 15. *pp.* 127–142, *March–April,* 1933.—The author's previous work [see Abstract 1150 (1932)] has shown that the extremes of spectral types of a variable star seem to correspond but precede (by a small amount usually) the extremes of ionisation. For this he shows that the spectral type depends both on the ionisation (x) and the coefficient of absorption (k) of the reversing lag $\{\mathrm{Sp} = \mathrm{f}\ (x : k)\}$; but the maxima ionisations correspond very nearly to the least advanced spectral type, the minima ionisations to the more advanced. The k of the reversing layer influences the appearance of the Cepheid variation and explains its lag; it alters the form of the light curve bringing about unequal periods for the ascending and descending branches. It is not sufficient to know x in order to know the spectrum; in some way x conveys the internal reality of the reversing layer of the star, but not its effective appearance, for its spectral type (and magnitude) depends also on k. The colour index (I) is also a function of x and k as well as of the temperature, and for equal magnitudes I is weaker for the ascending branch of a Cepheid light curve, than for the descending branch. A. S. D. M.

2865. Multiple System of Zeta Cancri. Maud W. Makemson. *Astron. J. No.* 988. *pp.* 153–157, *April* 19, 1933.—In 1756, Mayer found Zeta Cancri to consist of 2 stars (A and B) 5″ apart. The brighter component was found in 1781 by Herschel, to be double and the new component C was found itself to have an invisible companion Cc. A table is given of the residuals of the orbit from AB—Zeta Cancri for 1825·27 to 1926·24; a graph from these indicates a periodicity due to an invisible companion (either to A or B), for the great distance and low mass of Cc precludes influence. An arc of 52° from 1820 to 1920 is available for the orbit of this centre of gravity of Cc about AB, and its elements are given; its time of periastron passage agrees closely with that of AB and its period is 1137 years or nearly 19 times that of the primaries. Compared with the solar system the multiple Zeta Cancri is very large; it consists of 2 stars, each equal in mass to the sun, revolving round their common centre of gravity in about 60 years, and a dark star or planet probably moves round one of them. C and c revolve round each other in about 17·6 years, and this pair revolves round the twin primaries in 1137 years. A. S. D. M.

2866. Stellar Colours. A. Brill. *Zeits. f. Astrophysik,* 6. 3. *pp.* 213–217, *April* 8, 1933.—A discussion of Seares' method for determining the colours of stars, showing under what conditions his indices give an accurate representation of stellar colours. G. C. McV.

2867. Comparison of Yerkes and Greenwich Photographic Magnitudes. S. Holm. *Astrophys. J.* 77. *pp.* 229–242, *May,* 1933.—A comparison has been made between the magnitudes of the Yerkes Actinometries: First and Second Series. The apparent differences between the two catalogues have been corrected for statistical errors. The remaining differences in the sense Second *minus* First Series are positive, indicating a scale correction of + 0·20 for stars brighter than 6·0$^{\mathrm{M}}$ and of + 0·03 for stars fainter than 6·0M. The Yerkes Actinometry: First Series has also been compared with the Greenwich catalogues of photographic magnitudes. This has been done in order that the scale corrections derived could be compared with the scale corrections obtained by F. H. Seares. The present method yields results which are generally in good agreement with those of Mount Wilson. Lack of agreement in the case of late-type stars is attributed to the probability that the linear relation between scale correction and colour index commonly employed may not be adequate for the purpose.

AUTHOR.

See also Abstracts 2770, 2772, 2839, 2878.

SUN.

2868. Height of Chromosphere in 1932 and Progress of Solar Cycle. G. Abetti. *Accad. Lincei, Atti*, 17. *pp.* 338–339, *March* 5, 1933.—Arcetri observations show a general increase in height of the chromosphere in 1932 compared with 1931. It continues to be highest at the poles and lowest at the equator, which probably indicates that the new cycle is beginning. This is confirmed by the total area of the prominences and the latitude of their principal maximum, both of which have remained practically the same in 1931 and 1932 in both hemispheres. M. A. E.

2869. Structure of Solar Chromosphere. E. J. Perepelkin. *Zeits. f. Astrophysik*, 6. *pp.* 245–258, *May* 11, 1933.—The author assumes that the chromosphere is composed of a large number of separate vertical filaments, which he calls " grass-blades " (*Grashalme*). He uses the variations of the measured height of the chromosphere to determine the frequency of filaments of differing altitude. Hence he explains the granular or rather " toothed " structure of the chromosphere and deduces an equation for the decline of intensity with altitude which agrees with the equation given by measures of eclipse spectrophotograms. An explanation of the fine structure of Hα spectroheliograms is deduced. The observed chromospheric radial velocity being a combination of the velocities of many filaments, the Doppler contour of chromospheric hydrogen lines is derived and found to agree satisfactorily with Unsöld's spectrophotometric investigation. T. L. M.

2870. Total Solar Eclipse of August 31, 1932. A. de la B. Pluvinel and D. Barbier. *Comptes Rendus*, 196. *pp.* 1345–1348, *May* 8, 1933.—The station was Louisville, Canada, and the sky was clear only during totality. Results: (1) 2 Coronal photographs showed discrete polar plumes and the N.E. Streamer (to 40′); one plate measured with an opacimeter gave the brightness of 6 isophotic lines (sky = 1) as 2·08, 2·87, 4·56, 11·4, 28·07, 72·3. (2) 3 slit spectroscopes (the slit being along a solar diameter at right angles to the polar axis) gave at each limb a continuous spectrum, similar to the solar and extended from Hα to Hη, but showing emission lines, and the green coronal (λ5303) and the red (λ6374) to 5′ and 3′ distance from the sun respectively; the chromospheric lines are seen as more numerous at the east limb than at the west limb. (3) 2 objective prism spectroscopes. (4) a photometer fitted with a diaphragm of circular openings for comparison of the total coronal light with the sky, giving it as 0·8 that of the full moon. (5) Another instrument for the comparison with Jupiter (which was near the sun) gave the coronal magnitude as − 10·9, Jupiter's being − 1·3; the brightness of a square degree of the sky compared with the corona gave 0·0156, showing that the sky is illuminated

during totality by doubly diffused solar light. (6) Lyot's instrument, for photographing the Corona out of totality, gave no results because of cloud.
A. S. D. M.

2871. Solar Eclipse Problems. J. H. Moore. *Science*, 77. *pp.* 375–382, *April* 21, 1933.—The author gives a *résumé* of observations of the chromosphere; the marked difference in the intensities in corresponding reversing layer and chromospheric lines is explained by the fact that ionisation depends on both density and pressure; the lengths of individual lines depend on intensities which are functions of abundance, atomic weight, ionisation potential, excitation potential, etc.; the researches of Mitchell and Menzel are discussed; also the determination of the absolute intensity of a spectral line; more infra-red observations are needed. In the corona, attention is drawn to the cyclical changes in coronal shape; to the connection of coronal " arches " with spot minimum and with actual prominences; little progress has been made with the coronal spectrum, but Lyot's work on the inner corona in full sunlight is notable; attempts made to measure the coronal rotation have not been very successful, and knowledge of the distribution of coronal intensity with distance from the sun is still unsatisfactory, but Bergstraus has done good work by the method of photographic photometry.
A. S. D. M.

2872. Total Eclipse of the Sun, August 31, 1932: Report of the Imperial College Expedition. H. Dingle. *Roy. Astron. Soc., M.N.* 93. *pp.* 340–345, *March*, 1933.—This expedition was stationed at the McGill University, Montreal, near the edge of the shadow, and the apparatus prepared was similar in principle to that arranged by Fowler for the eclipse of 1914, but differed in detail. The object was to photograph the bright line spectrum at the cusp of the partially eclipsed sun, and also the Fraunhofer spectrum near the limb just before and after totality. Each spectrum was to be provided with at least one comparison spectrum of iron, and the whole programme would have taken nearly an hour to carry out. The weather made any result impossible, but valuable experience was gained.
M. A. E.

2873. Changes in the Solar Constant. F. Baur. *Monthly Weather Rev.* 60. *pp.* 242–246, *Dec.*, 1932.—This paper consists of three sections. In the first the author examines the latest solar constant measurements of Abbot for the two periods 1919–1923 and 1924–1930 and shows that in each case a 12 month periodicity occurs. From this he points out that the earth plays a part, although in the second set the effect is less than, and in the opposite sense to, that in the first owing to a new empirical relation having been used in determining the transparency of the atmosphere. An improved formula is hoped for. In the second section, the effect of sunspots and the value of the solar constant is dealt with, the period reviewed being as before. No linear relationship is found, but values of the constant below normal appear near both a sunspot minimum and a sunspot maximum with values above normal in the years between. An attempt is made to explain this, but a longer period is needed from which to draw accurate conclusions. In the third part it is pointed out that similar relationships are found between certain meteorological phenomena, such as severe winters and dry summers, and sunspots, the former coinciding with maximum and minimum periods, the latter with the years between. The author in an addendum deals with a point raised by Abbot who considers that the period referred to in section A is one of 11 months instead of one of 12 months. A. E. M. G.

2874. Error in Measurements of Solar Radiation Due to Assumption of Constant Ratio between Radiant Energy Received and Electrical Energy Recorded. H. H. Kimball and I. F. Hand. *Monthly Weather Rev.* 61. *p.* 4, *Jan.*, 1933.—Reference is made to a recent paper by Middleton regarding this source of error [see Abstract 4829 (1932)]. The authors tabulate comparisons made between a Marvin pyrheliometer and two thermoelectric pyrheliometers when pointed always towards the sun. These show a decreased intensity of the thermopile with increase in radiation intensity. When further the instruments were exposed with their surfaces normal to the incident solar rays the thermopile is less effective with high solar radiation intensity than with low intensity but the opposite is true when the thermopile is exposed with its surface horizontal and the decrease in sensitivity of the thermopile with low radiation intensity is due to a lower absorbing power or higher reflecting power of the surfaces with increase in the angle of incidence. Serious errors in the hourly amounts of radiation received upon a horizontal surface do not arise since with low sun the direct solar radiation component of the total radiation received on a horizontal surface becomes relatively less and less important. R. S. R.

2875. Solar Radiation in 1929 and 1930. G. Armellini and G. Andrissi. *Accad. Lincei, Atti*, 17. *pp.* 333–338, *March* 5, 1933.—Since 1876 at the Campidoglio Observatory the horizontal diameter of the sun has been observed and measured every clear day at meridian passage. As the slight systematic differences found are doubtless connected with other solar phenomena, daily statistics of sunspots and also of solar radiation measured with a pyrheliometer were added in 1929. The pyrheliometer results for 1929 and 1930 are given. M. A. E.

2876. Intensity and Spectral Distribution of Solar Radiation in New Orleans. H. Laurens and H. S. Mayerson. *J.O.S.A.* 23. *pp.* 133–142, *April*, 1932.—For their possible use in questions of heliotherapy measurements of solar radiation were made over 56 months using a pyrheliometer to determine the direct and diffuse radiation from the sky and employing appropriate screens for work in different ranges of wave-length. For normal incidence the maximum values of solar radiation were found in March and October and exceeded 1·4 cal./cm.^{2}min. For total radiation on a horizontal plane (sun and sky) the maximum over the last 15 months was in June on clear days only, and in May, 1931, and June, 1932, for all days, clear and cloudy. For the range 620 $m\mu$ to 1·4μ the energy of direct solar radiation is greater in early spring than in summer and autumn, while for wave-lengths $>$ 1·4μ there is a gradual increase from winter to summer. For the luminous component (400–620$m\mu$) little seasonal variation occurs. The ultra-violet radiation fluctuates considerably, exceeding 0·05 cal./cm.^{2}min. in all but April and the winter months and being 5% of the total radiation. Antirachitic radiation ($<$ 313 $m\mu$) varies most, 0·0004 cal./cm.^{2}min. in winter to 0·0014 cal./cm.^{2}min. in summer. Wave-lengths below 306$m\mu$ are seldom found in winter and in the rest of the year little occurs below 302$m\mu$. On one occasion 299$m\mu$ was found. Sky radiation increases from 0·06 cal./cm.^{2}min. in winter to 0·13 cal./cm.^{2}min. in summer. On clear days at noon it comprises 7 to 17 % of the total radiation and is contained 20–30 % in the infra-red

($<620m\mu$), 30–40 % in the luminous (400–$620m\mu$) and the remainder in the ultra-violet. Through the year radiation from the sky has not less than half the antirachitic radiation present in sunshine. R. S. R.

2877. Colour of Eros and Southern Primary Reference Stars, and Solar Parallax Errors due to Atmospheric Dispersion. H. Horrocks. *Roy. Astron. Soc., M.N.* 93. *pp.* 346–362, *March*, 1933.—Atmospheric dispersion causes differing refraction displacements of images of stars of different colour; systematic error in derived solar parallax will only be avoided if the displacements for Eros and the mean of comparison stars are the same. The author uses the distances between first-order images in coarse grating photographs to supply a selection criterion and supplies the necessary corrections to be applied for reduction to a homogeneous system. The effect of differing exposure times, of the variation of magnitude of Eros, etc., is considered. The use of refractors is favourable to a determination of parallax with small error due to colour; but systematic errors due to the magnitudes of the comparison stars and their positions on the plate still arise from the effect of atmospheric dispersion. T. L. M.

2878. Direction and Magnitude of Sun's Motion Referred to Stars of Different Apparent Magnitudes. F. K. Edmondson. *Astron. J. No.* 988. *pp.* 157–158, *April* 19, 1933.—Seares took the sun's speed to be a variable depending on the apparent magnitude (m) of the reference stars, but considered the direction of the apex to be independent of m. To check this, the author uses the radial velocities of 7 groups of stars of different apparent magnitudes. He gives data, method of reductions, and numerical results; and finds that faint stars give an apex to the east of that given by the brighter stars; but the apex in latitude is smaller for fainter stars because with faintness, more and more galactic stars are included so that the motion is confined more closely to the plane of the galaxy. [See Abstract 509 (1933).] A. S. D. M.

2879. Sulphur Lines in the Solar Spectrum. K. W. Meissner. *Zeits. f. Astrophysik*, 6. *pp.* 330–332, *May* 11, 1933.—A number of lines of the solar spectrum, hitherto unclassified, are found to coincide in wave-length with a series of multiplets of the sulphur arc spectrum. Although the agreement between the wave-lengths of these lines in the sun and those obtained with a laboratory source is not sufficiently good to be alone convincing proof of the presence of sulphur in the reversing layer, the presence of whole groups of these lines in the solar spectrum leaves no further room for doubt of this fact. J. E. K.

2880. Photometric Measures in Atmospheric Oxygen Band A of Solar Spectrum. H. v. Klüber. *Zeits. f. Astrophysik*, 6. *pp.* 161–175, *April* 8, 1933.—A series of spectra of the solar band A (λ 7600) was obtained with the grating spectrograph of the Tower telescope in Potsdam, and the width of the doublets in the P section of this band at different altitudes of the sun has been measured. It is found that the square of the line-width is proportional to the secant of the sun's zenith distance, which is according to expectation if damping by collisions is the main cause of the widening. About 9/10ths of the absorption of the whole system of bands is due to the A band. An approximate estimate of intensities of the lines in the P section is made. M. A. E.

See also Abstracts 2809, 2895, 2902, 2913.

GEOPHYSICS.

GEODESY.

2881. Physical Geodesy. F. Hopfner. *Gerlands Beitr. z. Geophys.* 38. 3–4. *pp.* 309–320, 1933.—The questions considered in the paper include: (1) Ackerl's formula for the estimation of undulations, (2) Ackerl's value of the oblateness of the level spheroid, (3) the range of application of Faye's free air reduction formula, and (4) the boundary problem of geodesy. Their applications are examined from theoretical and practical considerations. [See also Abstracts 3636 and 3637 (1932).] R. S. R.

2882. Figure of the Earth. B. L. Gulatee. *Gerlands Beitr. z. Geophys.* 38. 3–4. *pp.* 426–430, 1933.—The author quotes the two theorems forming the main theme of Stokes' paper in 1849 on the variation of gravity at the earth's surface and derives the fundamental formulæ. The determination of the figure of the earth consists in finding (1) the ellipticity (ϵ) of the natural geoid considered as a whole, and (2) the elevation (N) of the natural geoid above some reference geoid in different regions of the globe, which provides ideas regarding the structure of the earth's crust. To get ϵ accurately a formula for g representing values on the geoid is deduced by some system of reduction from observed values on the earth and free air anomalies are used with data for g over the globe. It is shown that free air reductions for N need not be used, but a hypothesis employed approximating to that in nature. Values of g free from local effects are obtained and the distortion of the geoid calculated. Using isostatic reduction a compensated geoid is found and its distance from the actual geoid determined, which gives the deviation of the actual from a reference geoid. Errors in Hopfner's views are pointed out. R. S. R.

GEOPHYSICS, APPLIED.

2883. Potential Distribution about an Electrode on the Surface of the Earth. M. Muskat. *Physics,* 4 *pp.* 129–147, *April,* 1933.—An analytical study is made of the potential distribution about an electrode on a stratified earth, from the point of view of developing special formulæ appropriate for computation at small and large distances from the electrode. Power series in the distance for small distances and simple asymptotic expansions for large separations are derived first for a two-layer earth, from integral expressions for the potentials. For graphical integration a transformation is derived which makes the integrals converge very rapidly. For a many-layer earth a general method for deriving the power series for small distances is indicated. For large distances, general expansions are given in closed and asymptotic forms applying to all types of conductivity variation. Explicit expressions for the power series are given for a three-layer earth with the middle layer of thickness equal to and twice that of the upper layer. Closed and very rapidly converging series of Hankel function expansions are then developed for the third layer having zero or infinite conductivities, with the thickness of the middle layer being equal to, twice and three times that of the upper layer. Thirty numerical cases have been computed and plotted as curves to illustrate the fundamental formulæ developed. In an Appendix general proofs are given for the asymptotic expansions of not only the type of integrals occurring in the present problem but also for integrals involving Weber and Hankel functions as well as the Bessel functions, and where these functions are of non-zero orders. AUTHOR.

2884. Tri-Dimensional Vibrograph. J. E. Shrader. *Frank. Inst., J.* 215. *pp.* 455–469, *April,* 1933.—To measure and record vibrations in machines or structures the apparatus used should show (1) amplitude of vibrations in three directions, (2) frequency of vibration, (3) wave-form of vibration, and (4) phase relations of vibrations in three directions at right angles to one another. To effect this purpose an instrument, the tri-dimensional vibrograph, has been devised and tested over a period of years with reliable results. It is a form of seismograph; its essential feature is a heavy cubic mass suspended in a frame by a system of springs. The relative motions of the mass and the frame, in three directions perpendicular to each other, are indicated on a scale or are recorded on a photographic film. The apparatus is described, with illustrations. The relative motions of the mass and frame are shown by the rotation of three spindles mounted upon the mass. The rotation is caused by a string wrapped round each spindle and fastened at each end to opposite sides of the frame by a short spiral spring. Light from a lamp is reflected from a small concave mirror attached to each spindle through a right-angled prism and brought to a focus on the scale. An extension of the base provides for mounting a small electric motor. The photographic attachment is fitted on the top of the housing. For visual observation of wave-form and amplitude of vibration a rotating mirror is provided. The working of the apparatus is described, and several examples of photographed vibrations are shown. W. N. Y. K.

See also Abstracts 2745, 2746.

HYDROSPHERE, PHYSICS OF THE.

2885. Dynamical Explanations of Tides. S. F. Grace. *Assoc. d'Océanographie Physique, Publ. No.* 1. [26 *pp.*], 1931. *In English.*—A review of dynamical explanations of tides in non-elongated enclosed seas and lakes (Part I) and in the Mediterranean, the Baltic sea, the Gulf of Mexico and the Arctic ocean (Part II).

2886. Tidal Bibliography. J. Proudman. *Assoc. d'Océanographie Physique, Publ. No.* 2. [17 *pp.*], 1932. *In English.*—Publications issued before 1910 and during 1929 and 1930.

2887. Measuring Machine for Tidal Curves. S. E. Stenij. *Soc. Scien. Fennica,* 6. 26. *pp.* 1–8, 1932–1933. *In German.*—The paper describes a self-recording measuring machine designed to measure records obtained with the Renquist-Witting automatic tide-registering apparatus, but it can be adapted to the measurement of any curves where records occur at abscissæ, which are equally spaced. The Renquist-Witting apparatus is also described and illustrated. W. A. R.

2888. Oscillations in a Bounded Water-Basin. S. E. Stenij. *Soc. Scien. Fennica,* 6. 16. *pp.* 1–79, 1932–1933. *In German.*—This is a long mathematical paper which does not lend itself to abstracting. The movement of water in a bounded basin is worked out for the case where the horizontal displacement of the water at any instant on each vertical is the same and independent of the depth. The influence of the air pressure-gradient is taken into account. W. A. R.

See also Abstract 2846.

LAND, PHYSICS OF THE.

2889. Variation in the Rotation of the Earth and Volcanic Eruptions. H. Nagaoka. *Imp. Acad. Tokyo, Proc.* 9. *pp.* 35–38, *Feb., and pp.* 87–90, *March,* 1933. *In English.*—In these papers some evidence is given showing a correspondence between periods of volcanic activity and fluctuations in secular variation of the rotation of the earth. It is considered possible that the change in the moment of inertia of the earth is produced by the flow of masses of liquid material under the surface of the crust, only a fraction of which appears at the surface as volcanic eruptions. The change in inertia would cause a variation in pole-shift. [See also Abstracts 4846 (1932) and 1395 (1933).] W. A. R.

2890. Minimum Capillary Rise in an Ideal Uniform Soil. W. O. Smith. *Physics,* 4. *pp.* 184–193, *May,* 1933.—The rise, into an ideal uniform soil, of liquid, under the action of capillary forces, differs from the steady flow across the soil. The steady transmission of fluids takes place through the continuous capillaries extending across the soil; the rise, under capillary forces, of liquid is from cell to cell. The hexagonal scheme of grains spaced at a distance $(2r + d)$, where d is a function of porosity, is used as a statistical representation of the soil; and the problem discussed from the standpoint of this packing. The fluid, in its passage through the long capillaries, flows through a cyclic capillary showing definite maxima and minima in each element; and likewise, the rise, from cell to cell, under capillary forces, is through a channel with definite maxima and minima. The minimum opening, of a cell, is the section defined by the plane of centres; the greatest is the section defined by the plane, parallel to the plane of centres, tangent to the grains of the cell immediately over the first cell. The greatest rise occurs when the minimum opening holds the meniscus and is observed by allowing the liquid to fall through the soil; the least rise should occur when the maximum opening holds the meniscus and should be observed by allowing the liquid to rise through the soil. Wetting phenomena introduce, however, complications affecting the minimum rise. Rings of liquid form, just above the meniscus, around the point of contact of each pair of grains, and carry the rising liquid higher until it attains a position where it is no longer able to reach the rings so formed; equilibrium then prevails at a rise intermediate to the two extremes just defined. The exact conditions controlling the rise phenomena are determined; the approximation, developed for the capillary equation, in an earlier paper [see Abstract 4730 (1932)] is then used, with these conditions, to calculate the minimum rise. The results are compared with the data given in the earlier paper; good agreement, within the experimental error, is obtained. AUTHOR.

See also Abstract 3081.

METEOROLOGY.

2891. Atoms, Molecules and the Atmosphere. S. Chapman. *Roy. Meteorolog. Soc., J.* 59. *pp.* 97–123, *April,* 1933.—" In devoting my Presidential Address to a condensed account of these minute particles, my hope is to add, in some small manner, to the interest and pleasure that the atmosphere affords to our Fellows." With this idea in front of him the author proceeds to deal with what is practically the development of the modern atomic theory of matter and the information acquired therefrom. An enormously wide field is covered, as may well be understood from the fact that protons, neutrons, packing constants, isotopes, ionisation potentials, quantum numbers, Zeeman and Stark effects, molecular formulæ, isotope effects in band spectra, resonance and Raman spectra, to mention but a few of the points, are all touched on. In concluding the author indicates how these matters all bear on atmospheric studies, such as the emission of light, the absorption of light, the composition of the atmosphere at great heights, and the energy changes at great heights affecting individual molecules. A. E. M. G.

2892. Effective Radiation of Heat from the Sky during the Day in Relation to Solar Altitude and Degree of Obscurity of the Atmosphere. E. G. Meyer. *Gerlands Beitr. z. Geophys.* 38. 3–4. *pp.* 339–352, 1933.—A series of measurements was made at Frankfurt and Kl. Feldberg on cloudless days and on some occasions of fog with a new actinometric measuring method to determine the distribution of effective radiation over the sky during the day with different degrees of atmospheric obscurity. Results are tabulated for different solar altitudes. The intensity of effective radiation is greater for tropical and sub-tropical air than for polar air in consequence of the greater amount of suspended particles. For fog, when uniform, the radiation is a maximum near the sun, but it decreases rapidly in a horizontal direction and less rapidly in a vertical direction. For thick fog the radiation intensity distribution is regular, but when thin, the sky radiation increases very rapidly towards the sun, but even for thin fog it is less than for a clear sky. A simple relation between the radiation and azimuth gives mean values for radiation intensities over an horizontal zone of the sky. It is shown that to calculate the total radiation of the sky, values of the radiation in the vertical and counter vertical only are required. R. S. R.

2893. Thermal Balance of a Water Drop in the Atmosphere and the Effect of Radiation on the Upper Atmospheric Layers. C. S. Durst. *Roy. Meteorolog. Soc., J.* 59. *pp.* 125–127 ; *Disc.*, 127–129, *April*, 1933.—Here the author, with the aid of a diagram, discusses the way in which a small water particle in the atmosphere gains or loses heat through long-wave radiation according as it is above or below a critical height. As a result it is found that over England this critical height is about 6 km. The effect of such particles on the surrounding air above and below the critical height is dealt with, and in particular, the effects at the base of the stratosphere. The author considers that the process he outlines provides a mechanism whereby the entropy of the air in this latter region can be increased. In the *Discussion*, attention is drawn to the effects of lateral radiation and also of solar radiation on the particle ; also to the behaviour of a cloud of particles as opposed to that of a single drop. A claim for the method as being at least a qualitative one, is maintained. A. E. M. G.

2894. Temperature of the Atmosphere at Levels Accessible to Air-Waves. F. J. W. Whipple. *Terr. Mag.* 38. *pp.* 13–16, *March*, 1933.—Vegard [Abstract 152 (1933)] expresses the opinion that the propagation of sound to great distances cannot be due to the existence of a warm layer in the atmosphere above 40 km. The author of the present paper considers that this view is not sound and from observations carried out both in England and in Germany endeavours to show that sound waves penetrate above 40 km. The path of the sound wave on a particular occasion is calculated. The portions within the troposphere are shown to be definite. To account for the observed time of the passage of the sound wave the author considers that there is an upward temperature gradient above 33 km., reflection occurring at 44 km. Above this, temperature still increases. The latter part of the paper deals with some probable causes of this increase in temperature with height. A. E. M. G.

2895. Maximum Day Temperatures and the Tephigram (tϕ Diagram). E. Gold. *Meteorolog. Office, Prof. Notes No.* 63. [9 *pp.*] 1933.—When upper air temperatures are plotted on a tephigram the lower part of the curve is frequently isothermal. The present note is written to assist in interpreting the tephigram in respect of the problem of probable rise of surface temperature during the day. A section of a tephigram is given and on it is plotted a curve from a hypothetical set of readings. Another curve shows the result when the atmosphere is warmed to be in a convective state up to the level where the two curves meet. The area between the two indicates the energy required to effect the change. This area must not exceed an area on the tephigram which corresponds to the day's solar radiation. The energy corresponding to 1 sq. cm. of the tephigram being found, the author shows how to deduce from the solar radiation and the tephigram the greatest heights to which an isothermal atmosphere will be changed to an adiabatic one in a single day in any month. Thereafter he deals with the possible corrections to be applied to the available solar radiation, giving, finally, a table of corrected heights. A. E. M. G.

2896. Pilot-Balloon Sounding and Gradient Winds. P. Berger. *Arch. des Sciences*, 14. *pp.* 159–185, *May–June*; 203–225, *July–Aug.*; 241–278, *Sept.–Oct.*; 307–350, *Nov.–Dec.*, 1932; 15. *pp.* 47–79, *Jan.–Feb., and pp.* 143–196, *March–April*, 1933.—Existing observations on the rate of ascent of pilot-balloons are discussed, and the velocity shown to depend largely on the turbulence of and vertical currents in the air; the coefficient of aerodynamical resistance, ψ, is less for a ballasted balloon, decreases with increased turbulence, and increases with the Reynolds number. Existing formulæ for calculating this velocity are shown to be unsatisfactory. The factors affecting the theoretical vertical motion are then discussed, and it is concluded that the actual differs substantially from the theoretical velocity, especially at the beginning of the ascent, and that such variation may entirely falsify deductions from theodolite observations, a great cause of uncertainty being the vertical component of the wind. Accordingly, neither altitude, direction, nor strength of wind can be safely deduced from such balloon ascents. The possibility of deducing these for flying heights from observations at such heights on neighbouring mountains is next examined by comparing the theoretical gradient wind as deduced from observations at five mountain sites near Zurich (702–2066 m.) with the deductions from balloon observations. It is concluded that these theoretic winds are quite as correct as those deduced from balloon observations, direction being best given by the density-gradient wind, velocity by the pressure-gradient wind. C. A. S.

2897. Breakdown of Steep Wind Gradients in Inversions. C. S. Durst. *Roy. Meteorolog. Soc., J.* 59. *pp.* 131–135; *Disc.*, 135–136, *April*, 1933.—Reference is made to the classification in an earlier paper [see Abstract 3608 (1932)] of convectional and frictional eddies. As an inversion of temperature forms the latter type tends to be damped out, but on some occasions violent eddying occurs which is even more intense than for this type of frictional eddies. An example of this for a height of 150 ft. in an anemogram for Cardington is reproduced. For Leafield a similar effect occurs for anemometers at 312 and 43 ft. The character of this eddying was shown to be closely related to the wind gradient. A comparison with the flow of fluids in pipes suggested that this type of eddying would occur when the wind gradient exceeds a certain critical value, but the effect would not reach quite to the ground. The author uses this effect to obtain an explanation of the diurnal variation of surface wind speed. In the *Discussion*, **G. T. Walker** referred to Ekman's original work and considered the application in the paper was not correct for surface wind changes. The author in reply shows that Ekman's views in a later paper are in agreement with the results obtained in the present paper. R. S. R.

2898. Growth of Silver Thaw. Y. Kodaira. *Geophys. Mag., Tokyo,* 7. *pp.* 1–8, *April,* 1933. *In English.*—In this note the author derives an approximate formula from which the growth of silver thaw round objects of cylindrical form, past which the air is moving, may be calculated. The integration of the equation found is difficult and so the author solves it by a numerical method. Tables of $(r - a)$ are compiled, corresponding to different radii "a" of objects encountered (10 cm. and 20 cm.), and different values of the factor α representing decrease of water content (0·1 and 0·3); and diagrams are constructed showing the distribution of silver thaw round the obstacles. They indicate that round a wire the distribution will be nearly circular. The author points out that the results apply only to objects fixed relative to the wind. A. E. M. G.

2899. Mean Values of Relative Humidity at Different Heights in the Atmosphere over England. L. H. G. Dines. *Roy. Meteorolog. Soc., J.* 59. *pp.* 157–162; *Disc.,* 162, *April,* 1933.—This paper gives tables of relative humidity from the surface up to 8 km. and also some notes on the probable relative humidity of the air in the stratosphere. The observations on which the paper is based are obtained from records got by a Dines meteorograph [see H.M. Stationery Office M.O. 321, 1929] attached to sounding balloons, 146 soundings in all having been taken. Two stations are used, Kew and Sealand Aerodrome. Each instrument used is calibrated to determine its scale value. In compiling his first table the author uses a two-month unit and records from both stations indifferently. The result shows great irregularities but by drawing smoothed curves monthly variations are obtained and tabulated. These results show a decrease in relative humidity with height. Again by assuming the mean values of temperature for different heights, the author compiles a table of vapour pressures which indicates that the moisture in the atmosphere over England is almost entirely in the region below 3½ km. height. In discussing the results from the stratosphere the author points out that there is a general tendency for the *recorded* relative humidity to fall while the instrument is in that region. Records indicate also that the humidity varies from day to day. From this he concludes, after dealing with various criticisms, that the relative humidity in the stratosphere does vary from day to day and that the region is a comparatively dry one. In the *Discussion*, attention is called to the efficiency of hair hygrometers near and below the freezing point, while another point raised is the probable indication from the tables of the presence of super-cooled water vapour clouds. A. E. M. G.

2900. Micro-Climatological Temperature and Humidity Observations with a Thermocouple Psychrometer. V. Rossi. *Soc. Scien. Fennica,* 6. 25. *pp.* 1–22, 1932–1933. *In German.*—Temperature and humidity were observed by thermocouples standardised against an Assmann psychrometer, at heights of 1, 6, 12, 25, 50, 100, 200, and 400 cm. from the ground, in a meadow, a fallow, and on a rock in the meadow, every 2 hours during 7, 7, and 3 days (all different) respectively, in July, 1930, at Lauttakylä 61° 11′ N., 22° 37′ E. about 90 m. north of Åbo in Finland. Causes of error and methods for their avoidance are discussed. The corresponding observations for the different days are averaged, and discussed in detail. As a rule the highest temperatures were recorded at 1 cm. from the ground, the highest average, 30·6°, occurring at 14 hours on the fallow, the lowest, 9·2°, at 2 hours on the meadow; the distribution of humidity (highest average 96·5 % at 0 hour and 6 and 12 cm. height, and the lowest 30·7 % at 14 hours and 400 cm. both on the rock) indicate that the surface of the earth is the limit layer. C. A. S.

2901. Variations in the Climate of York During the 60 Years 1871-1930 and Comparison with Oxford. E. G. Bilham. *Roy. Meteorolog. Soc., J.* 59. *pp.* 137–149; *Disc.,* 149–150, *April,* 1933.—Observations of temperature and rainfall (1871–1930) and sunshine (1881–1930) at York are discussed to determine any noteworthy changes in monthly and seasonal values for the two periods prior to and since 1900. A comparison is also made between the records at York and Oxford, taken as typical of the north and south of England respectively, and the whole of England and Wales. It is concluded from the observations that while at York the rainfall and sunshine increase and decrease together in winter and oppositely in the rest of the year there is no evidence of any systematic climatic change. A definite cause tending to raise the temperature, particularly in the winter months, has been operative in the last 60 years, but whether it is part of a long period cycle is at present doubtful. It is found that the new normals based on the period 1901–30 in comparison with 1881–1915 are higher for temperature in all months. In the *Discussion,* **McClean** mentioned that many records of rainfall in Scotland indicated a lower annual average for the period 1875–97 than for 1898–1920, the drier years coinciding with the colder winters. R. S. R.

2902. Symposium on Climatic Cycles. *Nat. Acad. Sci., Proc.* 19. *pp.* 349–385; *Disc.,* 386–388, *March,* 1933.—At a conference on climatic cycles in April, 1932, following some introductory remarks by the chairman the following four papers were read: "Introductory Remarks," by **J. C. Merriam.** The aim of those engaged in research on determining the existence of climatic cycles, and on what the main influences are which may cause those cycles, is indicated. Special attention is drawn to solar and other radiation effects. The particular line followed on each paper is thereafter briefly indicated. "Evidences of Cycles in Tree Ring Records," by **A. E. Douglass.** The author considers that tree ring records dating back to a maximum time of 3000 years and a cyclogram method of analysis of the plotted curves warrant the search for a theory of climatic change based on cycles. He gives a description of the cyclogram and shows how this method of analysis can distinguish between genuine and accidental cycles. Applying this method to tree ring records he finds that in the trees examined from various parts of the earth cycles are apparent. In each case these are simple fractions of a small multiple of the 11-year sunspot period. When the device is applied to the sequoia records, which date back over a period of 3000 years, a 23-year period or some subdivision of it is found in a large number of the curves drawn. A recurrence cycle of about 275 years also appears and a diagram shows the sequence of different short cycles in this cycle. The method is regarded as promising in the formation of a theory of long range forecasting. " Periodicity in Solar Variation," by **C. G. Abbot and (Mrs.) A. M. Bond.** The results given in the first part of this paper are based upon work extending over many years in different latitudes and at different altitudes on the earth's surface and also from records obtained with sounding balloons. Evidences of the variability of the sun's emission have been found and diagrams show that these are in agreement for stations widely separated. An analysis of the best results indicates that the curve of variation consists of seven regular periodicities. Several of these are closely related to the sunspot period 11¼ years. The second part of the paper is devoted to an attempt to find whether these periodicities of the sun's emission are traceable in temperature departures of the weather. The observations from three stations in the U.S.A. widely separated, are examined for this. Periodicities are found at each of the stations, and a majority of the periodicities in terrestrial temperature are found to be identical in length with those in solar variation. The authors consider that the analysis appears to indicate that where the periods are identical, the major part of the temperature departures from normal are due to the variation of solar radiation, but that further investigation is necessary for complete establishment of this relationship. " Nature of the Solar Cycle," by **W. S. Adams and S. B. Nicholson.** The object of this paper as stated by the authors is to call attention to the astronomical facts relating to the nature of the solar cycle which should be recognised when correlations with sunspots are being investigated. With this end in view they first show how the Wolf Numbers may be taken as the most homogeneous index of solar activity. Other criteria may be used, but in the majority of these cases the periods of observations have been short and so their value is less. As regards the relation between sunspots and the measure of total solar radiation they conclude that this is not adequately given by stating that high values of solar radiation are associated with the sunspot maximum and *vice versa.* The correlations between sunspot frequency and weather found by many writers are then discussed. When the relation with tropical temperatures is examined, it is seen that if the solar cycle be used to improve the prediction, an appreciable though not striking gain is got. From observations other than those examined the same kind of result is reached, so that the correlation found is probably real. In conclusion the authors refer to other correlations with solar activity, the most marked being that with terrestrial magnetism. " Correlation of Sedimentary and Climatic Records," by **I. Bowman.** Many years ago it was observed that clays indicated appearances of annual banding. The interpretation of sediments has now advanced and reached a stage where tentative correlations between equivalent records from separate localities and records of greater precision, *e.g.*, from solar radiation results, have been adopted. The present paper deals with such correlations. The author indicates clearly the care that must be exercised in work of this type. " Sediments," he concludes, " like some tree rings may express the complex result of many agencies. In an attempt to correlate sediments, climatic changes . . . we are confronted with the difficulty of dilute effects." For further advance the author considers that a new technique of study of sedimentation process is desirable. In the *Discussion*, the speakers while recognising to the full the value of the work already carried out by the authors of the preceding papers, and while urging them to carry their research still further, utter notes of warning. Thus it is pointed out that the mathematical analysis of a graph into a series of hidden cycles has sometimes no physical meaning. Also in any analysis, where a cycle is found, certain of its subharmonics are also sure to appear. It is further suggested that other factors hitherto not considered may play a very important part, and that a search for these and their effects be made. The whole problem of the unravelling of climatic cycles is thus shown to present difficulties so great that the solution of the problem of successful long distance forecasting based on such cycles is one that is still in the far future. A. E. M. G.

2903. Visible Part of the Auroral Spectrum. L. Vegard. *Zeits. f. Physik*, 81. 7–8. *pp.* 556–559, *March* 30, 1933.—A correction of previous measurements [see Abstract 537 (1933)] rendered necessary by a later discovered displacement of the comparison spectrum, now shows that the difference between the red lines 6303 and 6368 and the nitrogen lines $^1D_2$–$^3P_{2,1}$ is not greater than experimental errors. A doubt is cast on the reliability of Sommer's results [see Abstract 1392 (1933)] in view of the small dispersion used by him. J. E.

See also Abstract 2909.

SEISMOLOGY.

2904. Earthquake Stresses in Rigid Building Frames. W. Porush. *Seismological Soc. of America, Bull.* 23. *pp.* 1–12, *Jan.*, 1933.—Considering a seismological impulse as simple periodic in type, the conditions of resonance of a framed structure are analysed. An application to the design of an earthquake-proof 10-story frame is given. J. P. A.

2905. Earthquakes, Spatial and Temporal Distribution. S. Yamaguti. *Tokyo Univ. Earthquake Research Inst., Bull.* 11. *pp.* 46–67, *March*, 1933. *In English.*—In Japan an earthquake is liable to be followed by another in the same district. Certain districts can be connected into a chain along which there is a frequent temporal sequence of earthquakes. From Asia epicentres are liable to be transferred towards South America, but not to Central America, and from Japan to the Philippines and to Australia. Epicentres are liable to travel round the Pacific coast in a counter-clockwise direction, especially do Japan and South America seem intimately connected in the matter of seismic activity. Rarely is there a transfer of epicentres over the Atlantic Ocean. Great earthquakes show a period of 27·5 days, which seems to correspond to the period, 27·3 days, of the rotation of the sun relative to the earth. For different districts in Japan local periods can be detected. W. A. R.

2906. Love Waves in Elliptic Coordinates. H. Arakawa. *Phys. Math. Soc. Japan, Proc.* 15. *pp.* 73–85, *Feb.*, 1933. *In English.*—Shallow earthquakes giving rise to Love waves, and accompanied by a shift of the seismic source, occur in Japan. From a treatment by elliptic cylindrical coordinates, the characteristics of the waves under these conditions are analysed. The amplitude of the transverse component of displacement diminishes inversely as the square root of the epicentral distance, that of the radial component much more rapidly. No vertical component exists. At a point whose epicentral distance is twice the length of the fault line associated with the shift of the source, the wave front is nearly circular. Brief confirmation from Japanese earthquake records is adduced. J. P. A.

2907. Elastic Waves from a Point in an Isotropic Heterogeneous Sphere. R. Yosiyama. *Tokyo Univ. Earthquake Research Inst., Bull.* 11. *pp.* 1–13, *March,* 1933. *In English.*—The case is considered of waves diverging from a point in an isotropic heterogeneous sphere in which the density ρ and the rigidity μ are constant, while λ is a function of r, the distance of the point considered from the centre of the sphere, only, given by $\sqrt{(\lambda + 2\mu)/\rho} = a - br^2$, where a and b are constants. It is shown that dilatational and distortional waves can be propagated independently.

C. A. S.

2908. Influence of Solid Friction on Dynamical Magnification of Seismographs. T. Hagiwara. *Tokyo Univ. Earthquake Research Inst., Bull.* 11. *pp.* 14–24, *March,* 1933. *In English.*—In the case where the ground movement is a stationary simple harmonic one, and the solid friction constant (the motion of the index being therefore periodic but not simple harmonic), provided that the constant of solid friction is small compared with the movement of the index, its effect is small, as also when the forced oscillation is very rapid. An expression is obtained relating the amplitude of motion of the ground to the seismographic record, the variation in that record with the character of the ground motion is examined, and the bearing of the results on seismograph construction discussed.

C. A. S.

See also Abstract 2741.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2909. Atmospheric Electricity and Föhn Sickness. W. S. van Leeuwen, J. Booij and J. van Niekerk. *Gerlands Beitr. z. Geophys.* 38. 3–4. *pp.* 407–425, 1933.—The authors discuss in considerable detail the results obtained by Israel, Schorer, Dessauer, and Strassburger and Happel relating to föhn sickness and the electrical conductivity of the air and its ionic content when these conditions result, while a series of tests were carried out to examine them. They found that the electric conductivity of the air was mostly raised during or before the föhn period compared with the normal and the negative conductivity can be overcome temporarily. These phenomena occur however outside the föhn period and they can fail while marked meteorological and physiological föhn phenomena are present. The number and sign of small and large ions oscillate daily and hourly, but the oscillations during marked föhn periods do not differ from the normal qualitatively or quantitatively. In a room where much smoke exists the number of large ions is much increased, the number of small ions falls to a minimum, and the electric conductivity approaches zero, but föhn phenomena are not altered. Further, in a room ventilated with air-free ions no improvement in föhn effects results. It is concluded that the sickness phenomena experienced by föhn-sensitive persons in Innsbruck before or during the föhn period are not in direct causal connection with atmospheric electric phenomena. R. S. R.

2910. Relations between the Combination Coefficients of Atmospheric Ions. F. J. W. Whipple. *Phys. Soc., Proc.* 45. *pp.* 367–380, *May* 1, 1933.—The principal object of the paper is to put forward for consideration a formula, $\eta_{12} - \eta_{10} = 4\pi e w_1$, which indicates that the combination coefficient η_{12} for small ions and large ions of the opposite sign exceeds the coefficient η_{10} for small ions and uncharged nuclei, and further that the difference between the two coefficients depends on the mobility w_1 of the small ions. The experimental evidence for the formula is discussed, as well as possible applications. AUTHOR.

2911. Gravitation and Earth's Magnetism. T. Schlomka. *Gerlands Beitr. z. Geophys.* 38. 3–4. *pp.* 357–406, 1933.—The paper begins with a short review of rotation theories of earth's magnetism followed by a review of previous theories of gravitation. The author's theory begins by assuming that the forces between protons and electrons are: for two protons, $(1 + \alpha)e_+ \cdot e_+/r^2$; for two electrons, $(1 + \beta)e_- \cdot e_-/r^2$; and for a proton and an electron, $e_+ \cdot e_-/r^2$. It follows that all the atoms of a material sphere are polarised in a radial direction, and a sphere so polarised will, when rotating, set up a magnetic field the intensity of which will depend on the value of $(\beta - \alpha)$. Taking the earth's field, a value $+ 0{\cdot}13.10^{-18}$ is found for $(\beta - \alpha)$. Further, it follows that electrically uncharged bodies will attract each other with a force proportional to $(\beta + \alpha)$, the value of which is determined as $- 0{\cdot}80.10^{-36}$. Certain conclusions depending on the values of α and β are indicated. G. E. A.

2912. Magnetic Declination over the Globe. (Miss) G. Homery and C. Maurain. *Comptes Rendus*, 196. *pp.* 797–801, *March* 13, 1933.—A chart has been constructed which shows for Jan. 1, 1931, the isogonal values for the globe using a Mercator projection with a scale of $1 : 2 \times 10^7$ at the equator. Corrections for secular variation have been applied and the information collected from many sources. Local perturbations have been neglected. Because of lack of information a smaller accuracy is obtainable over the ocean and some land areas. R. S. R.

2913. Time-Interval between Solar Phenomena and Terrestrial Magnetic Disturbances. C. Maurain. *Comptes Rendus*, 196. *pp.* 1182–1186, *April* 24, 1933.—The statistical method was applied to the observations of the years 1883–1923, and the mean interval between the solar activity and the following magnetic disturbance was 2½ days. When ten years of minimum activity were examined, the interval obtained was 3¾ days. The conclusions of other authors are also set down. Stagg, taking the years 1890–1924, found an interval of 4 to 5 days, but for the years 1906–1925 the period was 2¾ days. Ricco for eight cases found an average of 45½ hours; Deslandres in two instances 45 and 47½ hours; d'Azambuja and Grenat in one case 31 hours; Greaves and Newton in 30 cases 0·9 day to 1·8 days; Hale found an average of 26 hours in five cases. The author examined thirty-four records for the years 1930–1932 and found that the intervals varied from 23·5 to 116·5 hours (mean 2½ days) and concludes as to the variability of the incidence of the magnetic disturbance after the passage of the sunspot across the central meridian. Certain cases of quasi-simultaneity of the two phenomena are discussed. G. E. A.

2914. Variation of the Horizontal Component around Days of Magnetic Calm. L. Éblé. *Comptes Rendus*, **196.** *pp.* **1429–1431,** *May* **8, 1933.**—The five calmest days of each month were chosen according to the registrations of the whole world. The differences of the horizontal component H from one day to the next were taken during the three days which precede and the three days which follow each of the calm days, then month by month the means of the five sets thus obtained were formed. These were arranged in groups over a sufficiently long period. The eleven years 1921–1931 of the solar cycle were considered. It was found that H continues on the average to increase after the calm day, then decreases the third day, sometimes a day later. This behaviour is general and the signs are found in the same order almost without exception both in the monthly means and in the annual means, but the magnitude of the differences is related to the position of the month in the year and the position of the year in the solar cycle. The phenomenon is inverse in the case of the vertical component which decreases around the calm day up to the following day inclusively. In the southern hemisphere the phenomenon is similar. The following hypothesis is given in explanation: The currents of the high atmosphere of which the quick variations are the cause of the perturbations produce with unequal velocities two secondary effects—a certain magnetic agitation preceding the principal phase of the perturbation, and a rapid diminution of H. The first may be due directly to exterior currents whilst the second may result from an induction in the mass of the earth. J. J. S.

2915. Low Auroræ. G. C. Simpson. *Roy. Meteorolog. Soc., J.* **59.** *pp.* **185–190,** *April,* **1933.**—The conclusions reached by Johnson, Chapman and Beals [see Abstract 1406 (1933)] regarding the existence of auroræ at low levels and audible sounds accompanying them are rejected on the following grounds: (1) the aurora is due to the electrical excitation of highly rarefied gases and the green line due to monatomic oxygen with an extremely long free path; it is possible to produce this at a height of 80 km. but not at the surface with the same colour and intensity; (2) the brush discharge from a conductor and the intense electrostatic fields are due to a drift or mist or ice crystals; (3) if the auroral streamer at 80 km. reached the ground unchanged its intensity and dimensions must be greatly increased; (4) the nearness of the aurora has been judged from its unusual brightness and mass of detail in the moving streamers; and (5) optical phenomena produced by light from the moon such as illuminated clouds, mist, or hills and haloes, have been mistaken for auroræ. Since for these reasons auroræ cannot be formed below 80 km. the associated sounds are very unlikely. There might be some form of objective sound associated with the aurora. R. S. R.

See also Abstract 2984.

RADIOACTIVITY.

2916. Radioactivity of Well Waters from Dumfries. J. Muir. *Roy. Techn. Coll. Glasgow, J.* 3. *pp.* 7–20, *Jan.*, 1933.—In this paper the measurement of the radioactivity of two artesian wells at the Crichton Royal Institution, Dumfries, is described. The old well, of total depth about 450 ft., penetrates a crust of agglomerate igneous rock 328 ft. thick, and then 107 ft. of red sandstone. It gives through a 2½-in. pipe a supply of from 60 to 90 gall. per min. The new well was sunk only 75 yards distant from the old one. After penetrating 161 ft., only about half-way through the igneous crust of rock, a sufficient supply was obtained through an 8-in. pipe, of 125 gall. per min. The water of neither well was found to possess any permanent radioactivity, residues obtained by evaporation to dryness being inactive. The water of the old well contains about 60×10^{-12} and of the new shallower well about 150×10^{-12} curie of radon per litre of water—a curie being 0·66 cubic mm. at 0° C. and 76 cm. pressure. AUTHOR.

2917. Distribution of Radium in Fractional Precipitation of Radiferous Barium Chloride. Branca E. Marques. *Comptes Rendus*, 196. *pp.* 1309–1311, *May* 1, 1933.—Steadily increasing proportions of the barium and radium in equal amounts of a solution containing $BaCl_2$ and $RaCl_2$ were precipitated by HCl. The proportion of Ra to Ba in the precipitate steadily decreases as the total amount of the precipitate increases. Detailed tables are given. C. A. S.

2918. Recoil Atoms. (Miss) C. Chamié. *Comptes Rendus*, 196. *pp.* 1107–1109, *April* 10, 1933.—An investigation is made of the diffusion of recoil nuclei at normal pressure and at distances from the source which are greater than their range. The nuclei investigated were the ThC″ nuclei which recoil from ThC. It is shown that, over a wide range, the results will be represented by the equation $I = I_0 e^{-kx}$, where I = the amount of ThC″ collected by a plate held at a distance x from another plate activated with ThC. I_0 and k are constants. The equation does not hold for values of x less than about four times the range of the ThC″ nucleus. J. E. R. C.

2919. Positive Electrons. Irène Curie and F. Joliot. *Comptes Rendus*, 196. *pp.* 1105–1107, *April* 10, 1933.—After reviewing the evidence for the existence of the positive electron some further expansion chamber experiments are described. By allowing the radiation excited from beryllium by α-particles to fall upon lead in an expansion chamber a number of positive electron tracks are observed. When the lead is replaced by aluminium the ratio (positive electrons) : (negative electrons) is very much reduced and it is therefore concluded that the positive electrons are due to absorption of radiation in the lead and are therefore emitted from the lead. This establishes their direction of travel and therefore the sign of their charge. By interposing a further block of lead between the beryllium and the expansion chamber the number of positive electrons decreases by about 50 %. It is deduced that the positive electrons are due to the absorption of a relatively soft component in the beryllium radiation. This is possibly the γ-radiation which accompanies the neutrons. An explanation of anomalous γ-ray absorption is offered on this basis. J. E. R. C.

2920. Radiation Excited by α-Particles in Fluorine. P. Savel. *Comptes Rendus*, 196. *pp.* 1482–1484, *May* 15, 1933.—Using an ionisation chamber containing argon or hydrogen under 30 atm. pressure to increase respectively the effect of γ-rays and neutrons, it is shown that the radiation emitted by fluorine (as CaF_2) under the influence of α-particles from polonium consists of apparently homogeneous γ-rays of mass absorption coefficient $\mu/\rho = 0{\cdot}058$ and energy $1{\cdot}3 \times 10^6$ eV, which are mainly photons, and of very penetrating neutrons, which are half absorbed by 5·5 cm. of lead. The minimum energies of the α-particles exciting γ-rays and neutrons are respectively 0·9 — 1·2 and 2·5 — 2·7 eV. These results combined with those of Chadwick and Constable [see Abstract 2889 (1932)] imply that there are at least two sources of γ-rays, due possibly to their being excited with and without capture of the α-particles as suggested for lithium [see Abstract 1840 (1933)]. C. A. S.

2921. Chemical Detection of Artificial Disintegration. F. A. Paneth and P. L. Günther. *Nature*, 131. *pp.* 652–653, *May* 6, 1933.—It is possible to detect amounts of helium as small as 10^{-10} cc. Small fractional (10^{-5}) contaminations of helium with neon can also be detected. Thus, it seems possible that the products of artificial disintegration should be detectable chemically. The authors have investigated the effect of bombarding oxygen with α-particles in the hope of detecting any neon which might have been produced, but with negative results. They have also investigated whether any chemical changes are produced by β-ray bombardment. It is hoped to obtain positive evidence by this method of the production of helium when lithium or boron is bombarded with α-particles. J. E. R. C.

2922. Atomic Disintegration at Low Voltages. R. Döpel. *Zeits. f. Physik*, 81. 11–12. *pp.* 821–823, *April* 18, 1933.—Lithium and boron were disintegrated by proton bombardment, using a canal-ray tube. Disintegration was measurable with lithium down to 10 kV accelerating potential, the number of particles produced increasing by a factor of about 10 for each increase of 10 kV up to 40 kV. With boron, the apparatus failed to show disintegration products below 30 kV. J. H. A.

2923. Nuclear Theory. E. Majorana. *Zeits. f. Physik*, 82. 3–4. *pp.* 137–145, *April* 29, 1933.—Following Heisenberg it is assumed that the stability of the nucleus can be ascribed to attractive forces overcoming the mutual repulsive forces of the nuclear protons. They may be divided up into attractions between protons and neutrons and between neutrons and neutrons. It is assumed that normally the former of these is the more important. In heavy nuclei the repulsive forces tend to become large compared with the attractive forces. The author develops the mathematical theory of such a nucleus, a statistical method being used for this purpose. J. E. R. C.

2924. Theory of the Nucleus. E. N. Gapon. *Zeits. f. Physik*, 82. 5–6. *pp.* 404–407, *May* 8, 1933.—An explanation of the anomalous absorption of γ-rays is put forward. The deviation from the Klein Nishina formula allows the number of free neutrons in the nucleus to be determined. This is supported by the experimental results of Meitner and Hupfield [see Abstract 1305 (1931)]. J. E. R. C.

2925. Neutrons in the Nucleus. Parts I and II. A. Landé. *Phys. Rev.* 43. *pp.* 620–626, *April* 15, 1933.—It is supposed that the nucleus consists of α-particles, neutrons and zero or one proton. The calculated mass defects Δm of the isotopes of a single element show an exact linear increase of Δm with the mass number and the Δm-difference of the isotopes of each element is fairly constant for even elements throughout the periodic system. The absolute values of the mass defects give a potential energy curve decreasing uniformly with increasing atomic number, but the curve rises again in the region of the radioactive elements. These facts support the suggestion that the isotopes of an element differ only by the number of neutrons present, the binding energy per neutron being about 0·009 for even elements and remaining fairly constant throughout the periodic system. The empirical rule that elements of odd atomic number have no isotopes of even mass numbers receives explanation. In several cases the lightest isotope of an element represents an arrangement of neutrons in a more or less closed shell; the heavier isotopes indicate the attachment of successive neutrons until with the heaviest isotope, a new outer shell is completed. Up to $Z = 16$, the neutrons occupy a first shell with a maximum of 2 neutrons. From $Z = 17$ to 28, an additional shell of 4 neutrons is built up, while from $Z = 32$ to 36, a third shell of 8 neutrons is formed. It is necessary to assume that between $Z = 36$ and 40, the inner shells are filled with 2 more neutrons; similarly between $Z = 50$ and 54. Evidence for this is seen in certain significant features of the binding energy. It is pointed out that the intensity distribution of the isotopes is indicative of their stability with respect to α and β transformations. F. C. C.

2926. Wave Mechanics Model of the Neutron. S. Flügge. *Zeits. f. Physik*, 81. 7–8. *pp.* 491–495, *March* 30, 1933.—The author takes the Dirac wave equation for an electron in the field of a proton and relaxes the boundary conditions by permitting a singularity at the origin. This leads to an additional eigen-energy $E = -0{\cdot}51 \times 10^6$ volt, which is of the right order of magnitude for the coupling energy of a neutron. The corresponding eigenfunction is worked out. The difficulties with the model are, however, that it does not obey the Fermi statistics and secondly, the radius is about 100 times too great. W. S. S.

2927. Interaction between Neutrons and Protons. J. Solomon. *J. de Physique et le Radium*, 4. *pp.* 210–220, *April*, 1933.—A critical study is made of the different models which have been proposed to account for the proton-neutron interaction. The assimilation of the neutron by a dipole leads to a comparison between the results of the classical and the quantum theories. Results are then sought as to the effective section of proton-neutron collisions. By supposing that the connection between proton and neutron in the H^2 isotope is of the same nature as the forces which come into play in a proton-neutron collision, it is possible to establish a relation between the effective section of the collisions and the defect in the mass of H^2. The relation agrees with experiment, and certain deductions are made as to the form and properties of the neutron. G. E. A.

2928. Collisions between Neutrons and Protons. P. Auger and G. Monod-Herzen. *Comptes Rendus*, 196. *pp.* 1102–1104, *April* 10, 1933.—Using a Wilson chamber with two cameras at right angles a study has been made of the variation of the angle between the path of a proton struck by a neutron and the path of the neutron. The protons appear to fall into two classes, one having energies of the order of 1/10 of those of the other. The fast protons obey the ordinary scattering law for elastic collisions. The distribution of slow protons appears not to follow this law. It is deduced that these are due to a group of slow neutrons in the beryllium radiation. J. E. R. C.

2929. Law of Force between Neutron and Proton. E. C. Pollard. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 397–400, *April,* 1933.—Heisenberg has explained nuclear stability as being due to an overcoming of the mutual repulsion between the nuclear protons by attractive forces arising from polarisation of nuclear neutrons. The author has founded a calculation of the heights of nuclear barriers upon this hypothesis. The energy corresponding to the height of the barrier should, in the case of the light elements, bear a linear relation to the atomic number. For light elements for which the height of the barrier can be estimated, this relation appears to be true. J. E. R. C.

2930. Mass of the Neutron. J. J. Placinteanu. *Comptes Rendus,* 196. *pp.* 1474–1476, *May* 15, 1933.—As the mass of the neutron is $<$ the sum of the masses of the proton m_p and electron m_e of which it has hitherto been regarded as composed, it is suggested that it consists of a proton combined with Dirac's electron of negative energy [see Abstract 2416 (1930)]. This gives results for both mass $(M_p - m_e)$ and energy radiated in agreement with experiment [see Abstract 4373 (1932)]. C. A. S.

2931. Direct Measurement of Intensities of Fine Structure of α-Particles. S. Rosenblum and P. Chevallier. *Comptes Rendus,* 196. *pp.* 1484–1486, *May* 15, 1933.—An improvement is described of the author's apparatus [see Abstract 1302 (1931)] in which among other modifications a Geiger counter is substituted for the photographic plate, so that individual α-particles can be recorded. Its use is exemplified by the determination of the fine structure of α-particles from ThC with results in close agreement with those obtained photographically. C. A. S.

2932. Magnet for α-Ray Spectroscopy. J. D. Cockcroft. *Journ. Sci. Instruments,* 10. *pp.* 71–74, *March,* 1933.—A new type of electromagnet has been constructed having a 1 cm. annular air gap of diameter 80 cm., and a radial width of effective field of 5 cm. Fields up to 18,000 gauss are obtained which are constant over the working space to 1 part in 1000. The magnet is used for the investigation of α-ray spectra by bending the tracks into semi-circles and using the focussing property of a magnetic field to separate the different groups. Groups of α-particles having an energy difference of 5000 electron volts can be separated and their relative energies measured. The power required for excitation of the magnet is about 300 watts for most α-ray groups, so that a battery can be used for supplying the current and great constancy of field obtained. AUTHOR.

2933. Technique for Determination of Radioactive Content of Liquids. R. D. Evans. *Rev. Sci. Instruments,* 4. *pp.* 216–222, *April,* 1933.—For the removal of radon from liquids, simplified apparatus, including a special reflux condenser, free from carry-over difficulties, is described. For the measurement of small quantities of radon or thoron, cylindrical ionisation chambers, with moisture proof insulation, together with a removable-head, evacuated, bifilar electrometer are described. The importance of constancy of the background ionisation due to cosmic and local radiation is emphasised, and precautions are described which insure a highly constant background in the present type of apparatus. AUTHOR.

See also Abstracts 2675, 2686, 2993, 3153, 3154, 3155, 3156, 3222, 3245.

RADIATION.

ABSORPTION AND TRANSMISSION.

2934. Absorption of Light by Solutions of Cobalt Chloride. S. B. Schwezow and A. M. Tanchilewitsch. *Phys. Zeits. d. Sowjetunion*, 3. 2. *pp.* 206–224, 1933.—The absorption curves of cobalt chloride in the visible region are measured for a range of concentrations in water, ethyl alcohol and concentrated hydrochloric acid, using a König-Martens polarisation spectrophotometer. It is suggested in general terms that the differences in the three cases are connected with differences in the degree of ionisation of the salt. From the absorption curve of a certain glass coloured with cobalt the conclusion is drawn that the colouring substance is in the dissolved state and that both undissociated molecules and ions are present. L. A. W.

2935. Light Intensity at Different Depths in Lake Water. H. A. Erikson. *J.O.S.A.* 23. *pp.* 170–177, *May*, 1933.—A quartz prism dispersing system in a specially designed housing was used for evaluating the intensities of different wave-lengths in the visible spectrum at different depths in water. The spectrum was photographed at different points down to 70 ft. and from these the intensities of the different wave-lengths were evaluated from characteristic curves obtained from standard exposures by using wire screens. It was found that the variation of the intensity with depth was exponential in the case of some wave-lengths but not in the case of all. From the results obtained, absorption constants were obtained for the different wave-lengths. AUTHOR.

2936. Absorption of Light by Adsorbed Iodine. J. H. de Boer and J. F. H. Custers. *Zeits. f. phys. Chem.* 21. *Abt.B.* 3. *pp.* 208–224, *May*, 1933.—The ultra-violet absorption of iodine adsorbed to different degrees upon calcium fluoride is measured photoelectrically. The absorption curves show maxima at 283 and $340\mu\mu$, which become more pronounced as the number of adsorbed molecules decreases. The adsorption isotherm is determined for low relative pressures and employed in calculating the absorption coefficient of the adsorbed iodine per atom per unit area. It is found that the molecules first adsorbed have a much stronger absorption than those subsequently adsorbed or than iodine in other states of aggregation and combination. Attention is called to the similarity between the absorption curves of adsorbed iodine and of the tri-iodides in solution. The significance of the two maxima and their possible relationship to the absorption spectrum of I_2 are discussed. In considering the possibility of dissociation and desorption as a result of light absorption the conditions are represented by means of potential surfaces in a spacial figure, the potential energy being taken as a function both of the distance between the nuclei and also of the distance of the molecule from the adsorbing surface. L. A. W.

See also Abstracts 2934, 2977, 2997, 3242.

COLORIMETRY.

2937. Trichromatic Colorimeter. H. P. J. Verbeek. *Physica*, 13*e*. 3. *pp.* 77–82, 1933.—Description of a trichromatic colorimeter with spectral primaries in which the mixing of the primaries is effected by means of a fixed prism. For the variation of the intensity of the three beams diaphragms are used. Also, another construction in which the intensity regulation is effected by light-absorbing liquids. Application of a double monochromator and monochromatic light sources in measuring the remission function of coloured objects. A. D.

2938. Photoelectric Instrument for Comparing the Strengths of Coloured Solutions. E. W. H. Selwyn. *Journ. Sci. Instruments,* 10. *pp.* 116–118, *April,* 1933.—The instrument described consists of an under-run projector lamp, the light from which is focussed down by a condenser to a small image at the position normally occupied by the cell containing the solution being examined. A double filter holder is arranged between the cell and the condenser to enable the colour of the beam of light to be made complementary to that of the solution. The light after passing through the cell goes on through a neutral uniformly-graded wedge to a photoelectric cell housed with a valve amplifier in a screened compartment. The cell is arranged for easy removal from the beam of light by mounting it on a turn-table operated by an external slide, whilst the neutral wedge can be moved across the face of the photoelectric cell by a rack and pinion, also externally operated. Finally, the method of calibrating the instrument and of using it to obtain measurements is described, the accuracy obtainable being one thousandth of the maximum concentration measurable. R. C. F.

2939. Neutral Grey Liquid Filter. E. Landt. *Zeits. f. Elektrochem.* 39. *pp.* 310–312, *May,* 1933.—Describes an experimental investigation of the neutral grey liquid filter devised by A. Thiel for use as a variable neutral absorption element in a colorimeter. The two liquids to be used in preparing the solution are marketed by Leitz of Wetzlar. The investigation covered three characteristics, (*a*) uniformity of transmission throughout the spectrum, (*b*) permanence, (*c*) change of transmission as a result of continued exposure to light. With regard to (*a*) ten solutions were made up independently and their extinction coefficients were measured at three wave-lengths. The range covered by the variations for a single solution varied from 2 to 8 %. As regards (*b*) it was found that a solution increased in transmission by about 15 % in the red portion of the spectrum after the lapse of a month. Under (*c*) exposure to either daylight or strong artificial light was found to increase the transmission considerably throughout the spectrum. Beer's law was found to be obeyed. J. W. T. W.

2940. Neutral Grey Liquid Filter. A. Thiel. *Zeits. f. Elektrochem.* 39. *pp.* 312–316, *May,* 1933.—A reply to the criticisms made in the previous paper [see preceding Abstract]. The author gives a table of extinction coefficients for three solutions. The ranges covered are respectively 5·4, 3·4 and 4·0 % the higher transmissions being sometimes in the blue and sometimes in the red. As regards permanence it is pointed out that the solutions should be kept in full bottles so that there is no exposure to air. As regards bleaching by light the author points out that it was always recognised that continuous exposure to light had to be guarded against. However, a new solution, much better in this respect is now available. J. W. T. W.

2941. Analytic Colour Tone Chart. R. D. Rusk. *J.O.S.A.* 23. *pp.* 182–183, *May,* 1933.—The author proposes a chart which shall represent for each hue the group of colours obtained by modifying the brightness and the saturation, and show in quantitative fashion the values of the latter properties for each colour. It is stated that the chart may be interpreted either in terms of pigment mixtures or mixtures of coloured lights. W. S. S.

2942. Colour Harmony. J. Littlejohns. *Roy. Soc. Arts, J.* 81. *pp.* 592–601; *Disc.*, 601–606, *May* 12, 1933.—The paper enlarges on the confusion existing in the classification of colours and in the statement of principles for predicting whether or no particular combinations of colours will produce a pleasing, æsthetic effect. The systems which have been proposed from time to time by artists and scientists are all criticised. The author proposes an experimental study by a group of experts of the æsthetic effects produced by colour combinations taken from the author's colour chart. In the *Discussion*, **R. F. Wilson** said that a standard colour chart was being prepared by the British Colour Council and the British Standards Institution, for use in industries throughout the Empire; **G. F. New** pointed out that the physical problem of colour specification had been solved, in its essentials, by scientists and he believed that progress on the physiological and psychological aspects of colour would come by application of the scientific method. W. S. S.

See also Abstract 2973.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2943. Distortion in Kerr Cell. E. E. Wright. *Phys. Soc., Proc.* 45. *pp.* 469–472; *Disc.*, 473, *May* 1, 1933.—The distortion due to the curvature of the (light, voltage) characteristic of a Kerr cell is discussed, and an expression giving the amplitudes of the Fourier components of the light-variation due to a pure alternating potential applied to the cell is obtained. Sets of curves showing the variation of percentage of second and third harmonic with bias and amplitude of the applied alternating potential are given. The working conditions for minimum distortion obtained from these curves agree with those used in practice. AUTHOR.

2944. Kerr's Law at High Field Strengths. J. A. Hootman. *Phys. Rev.* 43. *pp.* 749–755, *May* 1, 1933.—Improved compensation methods similar to that of Beams have been utilised to study the validity of Kerr's law in different liquids. In the pure nonpolar carbon disulphide the law was found to hold within the limits of precision of one-eighth of 1 % up to the highest field the liquid could sustain. In the polar liquids, ethyl ether and chloroform, on the other hand, easily measurable deviations were found. Curves showing the variation of the Kerr constant as a function of the electric field strength are given for ethyl ether at $-78 \cdot 5°$ C. and chloroform at $-22 \cdot 5°$ C. AUTHOR.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2945. Intensity of Fluorescence of Sodium Salicylate. P. Dubouloz. *Comptes Rendus,* 196. *pp.* 1221–1222, *April* 24, 1933.—Using the method previously described [see Abstract 2400 (1932)] save that dextrin was absent, curves relating intensity of fluorescence to the intensity of the incident light have been obtained with a carbon arc, and a tungsten filament lamp. These confirm previous results [see Abstract 2275 (1927)] and show that curves obtained with solid sodium salicylate are parallel to those obtained with its aqueous solution. C. A. S.

2946. Quantitative Study of the Inhibiting Action of Certain Organic Compounds on the Fluorescent Power of Uranine. J. Bouchard. *Comptes Rendus,* 196. *pp.* 1317–1318, *May* 1, 1933.—Measurements made on mixtures of uranine with a number of colourless inorganic compounds [see Abstract 1850 (1933)] show that, with constant small concentration (s) of the organic compound, the fluorescing power is a decreasing exponential function of the concentration (c) of the uranine. When c is constant, the fluorescing power is a decreasing exponential function of s in the mixture. If Φ_0 is the maximum specific fluorescent power related to unit mass of the fluorescing substance and Φ that of a mixture, $\Phi = \Phi_0 e^{-(kc + hs)}$. For some of the compounds studied, h and k are linear functions of c and s respectively, *i.e.*, $h = k_0 - \beta s$ and $k = k_0 - \alpha s$. If $\alpha + \beta = a$, $\Phi = \Phi_0 e^{-(k_0 c + h_0 s - acs)}$. The inhibiting power of the added substance is characterised by the coefficients h_0 and a. For a number of compounds the values of these coefficients are practically zero. T. H. P.

2947. Constitution of Phosphorescent Centres in Calcite. S. Iimori. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers. No.* 414. *pp.* 189–200, *March,* 1933. *In English.*—It is considered that the luminescent centres consist of aggregations of colloidal particles of Ca, F and impurity atoms. For kathodoluminescence or radio luminescence, the initial presence of such centres is not required, their formation occurring during irradiation. The author distinguishes between permanent centres (stable aggregates) and temporary centres (unstable aggregates). J. E.

2948. Thermoluminescent Spectrum of Calcite. S. Iimori. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers. No.* 419. *pp.* 274–284, *April,* 1933. *In English.*—It is found that the thermoluminescent spectrum of a sample of calcite is in close agreement with the spectrum of burning calcium. It is considered that the frequency interval characterising the luminescent spectra of mineral phosphors is due to the base, the activating metals dominating the intensity distribution. The theory of colloidal aggregates given in the previous paper is applied. J. E.

2949. Afterglow of Nitrogen as a Method for Testing the Purity of the Gases Used for Filling Glow Lamps. J. A. Elzin. *Zeits. f. Physik,* 82. 9–10. *pp.* 620–633, *May* 23, 1933.—The influence of admixtures of oxygen and hydrogen on the afterglow of nitrogen is investigated and a method is evolved for testing the purity of the gas used for filling glow lamps. It is established that the impurities of oxygen and hydrogen are gradually driven out from the gas by the passage of the h.f. discharge. The construction of an apparatus for testing the purity of the filling gas is described. J. E. K.

2950. Spurious Ring Exhibited by Fluorescent Screens. J. V. Hughes. *Phys. Soc., Proc.* 45. *pp.* 434–439 ; *Disc.,* 439–440, *May* 1, 1933. The spurious ring exhibited by fluorescent screens used for the observation of electrons is explained as being due to total internal reflection of the light at the upper surface of the glass block of the screen. The theoretical intensity-distribution is deduced and is compared with experiment by the use of a specially designed photometer. The experimental results agree well with the theory. AUTHOR.

See also Abstracts 3036, 3037.

INTERFERENCE. DIFFRACTION AND SCATTERING.

2951. Interference of Wide-Aperture Cone of Light. S. I. Wawilow and E. M. Brumberg. *Phys. Zeits. d. Sowjetunion*, 3. 2. *pp.* 103–114, 1933. *In German.*—When a source of light sends out two beams in different directions, their ability to interfere with one another when brought together by a suitable optical system, can only be analysed by resolving the vibration of each pencil into two plane polarised beams and considering each beam separately. The paper discusses various cases in this manner and shows how, in certain circumstances, the interference effects of the two pencils will just be neutralised when they originate from the source in opposite directions. An experimental arrangement which has been used to verify the conclusions, is described and includes an ultra-microscope with suitable condenser and polarising device. W. D. W.

2952. Standing Light Waves. Repetition of an Experiment by Wiener, Using a Photoelectric Probe Surface. H. E. Ives and T. C. Fry. *J.O.S.A.* 23. *pp.* 73–83, *March*, 1933.—The use of a photoelectric probe surface has yielded quantitative results compared with the qualitative results obtained by the photographic and fluorescent methods of Wiener, and Drude and Nernst. Details of the experimental method are given, and some insight into the influence of optical conditions on the photoelectric effect of thin films of alkali metals has been obtained. W. R. A.

2953. New Form of Michelson's Experiment. A. Sesmat. *Comptes Rendus*, 196. *pp.* 1099–1100, *April* 10, 1933.—On the hypothesis that radiant sources only give up energy to material receivers where they encounter them [see Abstract 2658 (1931)] the time of transmission to moving receivers must not be reckoned along the straight line joining source and receiver, but along the " curve of pursuit " directed at every instant towards the receiver. Now Lalan has shown [see Abstract 2659 (1931)] that in a vacuum the laws of reflection strictly apply to bodies in uniform rectilinear translation. If a transmitting medium is concerned, there might be a " drag " of the fringes even in air, which should be enhanced if the beam traverses water or carbon bisulphide. E. E. F. d'A.

2954. Talbot's Bands. A. C. G. Beach. *Phys. Soc., Proc.* 45. *pp.* 474–481 ; *Disc.*, 481, *May* 1, 1933.—The author discusses the form of diffraction pattern observed in a spectroscope when a point of light is produced on the slit of the collimator, and an aperture in which the upper or lower half is covered with a retarding plate is between the collimator and telescope. He uses the bands so produced as a means to explain Talbot's bands, and shows how the method helps to find the best aperture-width to exhibit them. A description of the experimental methods and photographs of the effect are given. AUTHOR.

2955. Extinction Coefficient for Dust in Short-Wave and Ultra-Violet Light. H. v. dem Borne. *Gerlands Beitr. z. Geophys.* 38. 3–4. *pp.* 265–275, 1933.—The investigations on the extinction coefficients of small atmospheric particles published earlier [see Abstract 4921 (1932)] showed that the extinction coefficient depended on the size of the nuclei in the wave-length region $2\cdot7\mu$ to $0\cdot55\mu$, which is well represented by the formula $a = \beta\lambda^{-\alpha}$, where α and β are constants, λ the wave-length, and a the extinction coefficient. Nuclei with a radius not smaller than $2\cdot5\mu$ show no connection of a with λ and this formula is satisfied only for those with a radius below 1μ while between these values α is not constant. It is found that α increases with decrease of particle size and for large damp particles

α is smaller than for dry particles. The wave-length dependence according to measurements with Hg lines extends to $0\cdot35\mu$. In this region α reaches a maximum, then a minimum at $0\cdot29\mu$ to $0\cdot28\mu$, and subsequently increases. The results are summarised in the following table for different nuclei :

Radius($\times 10^{-4}$cm.)	2·5	1·7	0·6	0·31	0·26	0·26	0·17
α	0	*Variable*	1·22	1·50	1·58	2·05	2·36
Maximum (at μ)	—	—	0·34	—	0·44	0·335	0·315

R. S. R.

2956. Light Distribution in Diffusing Media. W. A. Fabrikant, W. L. Ginsburg and W. L. Pulver. *Zeits. f. Physik*, 81. 11–12. *pp.* 795–798, *April* 18, 1933.—The paper discusses the scattering of light produced when a parallel beam of light is incident normally on a diffusing medium such as a piece of opalescent glass. In particular the light diffused in a direction perpendicular to the incident beam is examined theoretically and experimentally, observations being made at various depths through the plate. An intensity maximum is found at some distance from the front surface of the plate and distribution curves are given for various conditions such as varying thickness of plate, varying wave-length and for plates with polished or matt surfaces. An equation is developed as a basis for the solution of such diffusion problems. W. D. W.

2957. Theory of Fluctuations and Critical Opalescence. Y. Rocard. *J. de Physique et le Radium*, 4. *pp.* 165–185, *April*, 1933.—The author develops at length his theory of opalescence due to fluctuations at the critical point, outlined in a previous publication [see Abstract 1001 (1933)]. Comments on the Ornstein-Zernike theory and its recent extension by Placzek and Didlaukies, are included. W. S. S.

2958. Multiple Interferometer for Analysing the Vibrations of a Quartz Plate. H. Osterberg. *Phys. Rev.* 43. *pp.* 819–829, *May* 15, 1933.—A multiple interferometer, by means of which the various types of vibrations in piezoelectric plates can be determined with a certainty far greater than has hitherto been afforded by other methods, is described and illustrated. It combines in a convenient form six interferometers for measuring the relative motion of any two plane surfaces of the vibrating plate. A simple analysis of the measurement reveals the type of vibration. Its application to the study of rectangular quartz plates is illustrated by photographs from two interesting and enlightening patterns appearing in a square plate of X-cut. These patterns have previously been studied by R. B. Wright and D. W. Stuart [see Abstract 312 (1932)] with the aid of lycopodium powder. They appear to be formed by two compressional wave-trains propagated in opposite directions in the plane of the plate and incident at angles much different from 90° upon the crystal boundaries. The directions of maximum and minimum outward displacement of the end faces are often those in which Young's modulus assumes a critical value. The actual form of these patterns is undoubtedly affected by the anisotropy of Young's modulus. Efforts to determine the above wave-trains with the aid of Huyghen's construction have not yet been successful. However it appears that this construction is capable of explaining why simple longitudinal patterns, of the open-ended organ pipe variety, have never been observed by the writer in the ordinary X-cuts. [See Abstract 1436 (1933).] AUTHOR.

See also Abstracts 2688, 2768, 2969, 3000, 3049, 3050, 3052, 3204.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2959. Elementary Processes of Photochemical Dissociation. L. Goldstein. *J. de Physique et le Radium,* 4. *pp.* 123–131, *March,* 1933.—An investigation, based on molecular models, of dissociation processes due to the absorption of light by diatomic molecules is made. The final state of the nuclear system is represented by a de Broglie wave. The nature and intensity of continuous absorption bands for a molecule having an electrical moment in its fundamental electronic state, and the bands accompanying dissociation processes allowing an electronic transition in the molecule are calculated. These absorption bands, relative to one initial state of vibration, are degraded towards the ultra-violet. The appearance of observed bands corresponding to the superposition of absorption processes for a series of initial vibrational levels can be explained by the intensities calculated for the individual levels. N. M. B.

2960. Photosynthesis in Tropical Sunlight. N. R. Dhar and A. Ram. *J. Phys. Chem.* 37. *pp.* 525–531, *April,* 1933.—This paper deals with the presence of formaldehyde in rain water which, in freshly collected samples, occurs to the extent of 0·001 to 0·00015 gm. per litre. The amount increases if the rain is preceded by bright sunny days, but with cloudy days and frequent showers, it may fall to zero. The rain water should be immediately analysed when collected, because a part of the formaldehyde is lost by vaporisation and another part by polymerisation. It is believed that this formaldehyde originates by the combination of carbon dioxide and water vapour present in the atmosphere via the absorption of ultra-violet light from the sun ; it cannot be due to the photo-decomposition of substances of vegetable origin. Formaldehyde vapour shows light absorption between 3700 and 2500 Å, the maximum being at 2935 Å, characteristic of aldehydes. It appears that not only does ozone absorb radiations of short wave-lengths from the sun, but also that the formaldehyde present in the atmosphere absorbs solar ultra-violet radiations and that the water molecules are thereby decomposed whereby the hydrogen set free reduces carbon dioxide to formaldehyde, which may be found at atmospheric heights less than those where ozone is generated. [See also Abstract 2635 (1932)]. H. H. Ho.

2961. Photosynthesis of Hydrogen Chloride. Part I. New Experimental Method ; Inhibiting Effect of Hydrogen Chloride. Part II. Oxygen-Free Mixtures. M. Ritchie and R. G. W. Norrish. *Roy. Soc., Proc.* 140. *pp.* 99–125, *April* 1, 1933.—A description is given of a method of measuring the rates of reaction and quantum efficiencies of the formation of hydrogen chloride. The extent of reaction at any given time is determined from the relative amount of light of a given wave-length which is transmitted by the residual chlorine. The wave-length suitable depends on the corresponding absorption coefficient and on the range of chlorine pressure to be employed, the results obtained indicating a marked inhibiting effect of hydrogen chloride in mixtures containing oxygen. When this inhibitory effect is taken into account, consistent results are furnished by all the gas mixtures, with and without oxygen, and the following expression is found to reproduce accurately the variation in quantum yield between the limits 10^5 and 10 :

$$\gamma = \frac{2\cdot 8 \times 10^3[H_2]\,[Cl_2]}{([Cl_2] + 1\cdot 7\,[HCl])\ (I_{abs.})^{0\cdot 4}}$$

where $I_{abs.}$ is the intensity of the light absorbed. The maximum quantum yield $1 \cdot 2 \times 10^5$ is obtained, this agreeing well with the results of earlier workers. In agreement with the finding of Chapman and Gibbs (*Nature*, 127. *p.* 584, 1931), the velocity of formation of hydrogen chloride is found to be proportional to a power of the intensity of absorbed light approaching 0·5 (actually 0·6). Reaction chains are thus terminated mainly by self-neutralisation. For such oxygen-free mixtures the atomic mechanism involves Nernst chains the atomic reactions of which are similar to those of the corresponding hydrogen-bromine reaction. On the basis of the data obtained, application of Christiansen, Polanyi and Herzfeld's scheme to the hydrogen-chlorine reaction yields results in general dimensional agreement with the relevant thermal and statistical data of other workers. T. H. P.

2962. Photochemical Separation of Isotopes. W. Kuhn and H. Martin. *Zeits. f. phys. Chem.* 21. *Abt.B.* 1–2. *pp.* 93–137, *April*, 1933.—Phosgene vapour at 1000 mm. pressure and containing iodine vapour (0·13 mm.) was subjected in a quartz apparatus to the action of light of wave-length 2816·179 Å, obtained from the aluminium spark spectrum by means of light-filters. This wave-length corresponds with an absorption band of the isotope combination $COCl^{35}Cl^{35}$ and effects photochemical decomposition of this molecule. The chlorine thus liberated was withdrawn from the gaseous mixture with the help of mercuric iodide, by which free chlorine or chlorine iodide is retained as mercuric chloride. About 2 gm. of this chloride was formed after the monochromatic irradiation had been continued for 6 months. Determination of the atomic weight by weighing the chlorine as silver chloride gave, for the chlorine liberated photochemically, the value 35·430, that for ordinary chlorine being 35·455. The possibility of separating isotopes under such conditions shows that even for such excited molecules, which absorb strictly discontinuously in the region of sharp band absorption, probability of a finite decomposition exists. Estimation shows that, of the molecules which have so absorbed the line 2816·179 Å that they attain the quantum state $p^1 = 4$, $q^1 = 1$, about one-fifth are decomposed, while the remainder return in the normal condition. This photochemical separation of isotopes must be regarded as a purely chemical process. Fundamentally it seems possible that, in certain cases, practically complete separation of isotopes may result from a single irradiation. T. H. P.

2963. Photostationary States of Geometrically Isomeric Acids. A. R. Olson and F. L. Hudson. *Am. Chem. Soc., J.* 55. *pp.* 1410–1424, *April*, 1933.—The equilibrium mixtures of maleic and fumaric, citraconic and mesaconic, and cis- and trans-cinnamic acids obtained on illumination with ultra-violet light are considered [see Abstract 2494 (1931)] with regard to the quantum efficiencies, energy changes involved in isomerisation, etc. T. H. P.

2964. Photolysis of Solutions of Alkali Metals in Liquid Ammonia. R. A. Ogg, Jr., P. A. Leighton and F. W. Bergstrom. *Am. Chem. Soc., J.* 55. *pp.* 1754–1766, *May*, 1933.—The photolysis of pure liquid ammonia and of solutions therein of sodium, potassium, and caesium has been investigated. The pure solvent undergoes no photodecomposition in short ultra-violet light, whilst formation of amide and

evolution of gaseous hydrogen occur with the alkali metal solutions. The quantum efficiency increases regularly with the concentration of the metal, but remains considerably below unity at all the concentrations studied. A distinct long wave-length threshold is found for the quantum efficiency and a maximum at about 2300 Å. Pure liquid ammonia absorbs light to considerably greater wave-lengths than the gas, whilst solutions of metals and of metal amides show continuous absorption throughout the ultra-violet. These results are regarded as constituting a direct detection of NH_2 radicals as one of the products of the photodecomposition of gaseous ammonia. Apparently these radicals and hydrogen atoms combine by three-body collision in liquid ammonia, and it seems probable that this reaction takes place in the gas and is one of the secondary reactions in the photodecomposition of gaseous ammonia. From the spectra of the amides, it appears likely that sodium amide is optically dissociated into a normal sodium atom and normal amide radical and is hence ionically bound. The same probably holds for potassium amide.
T. H. P.

2965. Intermittency Effect and the Reciprocity Law Failure in Photographic Exposure. J. H. Webb. *J.O.S.A.* 23. *pp.* 157–169, *May*, 1933.—Experimental determinations of the intermittency effect and the reciprocity law failure were made on the three types of emulsions : high-speed ordinary, low-speed ordinary, and high-speed panchromatic. It was found that the intermittency effect became identical with the reciprocity law failure for frequencies of flash above a critical value, f_c, which varied with different emulsions and with the average intensity I_{av} at which the intermittent exposure was made. A theory based on the assumption that f_c is that frequency which allows on the average but one quantum per flash per effective receptive area ρ of a grain, yields the formula $f_c = \rho I_{av}$. This formula agrees with the experimental facts found and further predicts the size of the effective receptive area ρ of the photographic grain. Values of ρ calculated from the above formula agree in order of magnitude with the size of the photographic grain, indicating that the entire grain is the effective receptor of quanta in exposure.
AUTHOR.

2966. Photographic Reversal by Desensitising Dyes. B. H. Carroll and C. M. Kretchman. *Bureau of Standards, J. of Research*, 10. *pp.* 449–464, *April*, 1933.—The latent image on an exposed photographic plate bathed afterwards in a desensitising dye solution is destroyed by a second exposure to light of a suitable wave-length. Quantitative measurements of density variation with wave-length are made on plates treated with five desensitising dyes. In three cases indirect determinations are made of the spectral distribution of energy absorbed by the dyed silver bromide. Good correlation is observed between reversal and energy absorption. Where the silver bromide and dye absorptions are sufficiently separated in wave-length, there are maxima corresponding to each. The Herschel effect in the absence of dyes is negligible and there is no evidence that it is increased by the dyes. It is shown that safranine produces either reversal or normal sensitisation, depending on the bromide ion concentration. The evidence supports the hypothesis that the process is an oxidation and is the reverse of ordinary sensitisation both chemically and photographically.
A. H.

2967. Latent Photographic Image. R. W. Pohl. *Naturwiss,* 21. *pp.* 261–264, *April* 7, 1933.—Describes the results of experiments whereby the latent image has been examined without the use of normal chemical development. These results show that the latency of the light action during the period between exposure and development is due to the small thickness of the silver bromide in commercial plates. The light sensitivity of photographic plates with silver salts is not peculiar to these alone, for the alkali halogen salts are just as sensitive, but no suitable chemical developer making this sensitivity apparent is known. The photochemical elementary process, for the particular case of the alkaline halides, is shown to be due to a storing of electrons in an arrangement which is made apparent by a new absorption spectrum, this spectrum being dependent on the lattice constant only. The electrons of the latent images inside the crystals can be split off by means of light or heat and can then be moved about by external electric fields, being visible as wandering coloured clouds. R. C. F.

2968. Solarisation. Part VI. Solarisation with Physical Development. H. Arens. *Zeits. f. wiss. Phot.* 31. 11. *pp.* 317–323, *April,* 1933.—Further examines the question of solarisation using physical development, with *p*-phenylenediamine as the developer, for a number of photographic layers [see Abstract 104 (1932)]. The results show that solarisation either does appear for both primary and secondary physical development, *i.e.*, development before or after fixing, or it does not, whilst with primary development it is more pronounced than with secondary development. Generally, too, photographic layers showing solarisation with chemical development will show it with physical development, the effect being more marked for chemical development. No simple relationship exists regarding the degree of reversal when solarisation appears with both chemical and physical development. In order to study the connection between the solarisation with physical development and the preparation of the emulsion, peptised emulsions have been examined. With these, solarisation with physical development is only hindered if the bromide ions are present at certain stages of the treatment of the emulsion. If, however, they are washed out during the manufacture of the emulsion and replaced after completion of treatment then no change in solarisation is apparent. At higher temperatures of peptisation, solarisation is facilitated, but again bromide ions do not produce any variations. R. C. F.

2969. Optical Properties of Photographic Films. E. Lau and J. Johannesson. *Zeits. f. Physik,* 82. 1–2. *pp.* 37–47, *April* 22, 1933. *From the Reichsanstalt.*—The scattering of light by photographic films is investigated for all degrees of blackening. Scattering by the gelatin preponderates for small blackenings. Scattering by the silver particles reaches a maximum for a blackening of 50 %, a result which may also be deduced theoretically. The total amount of scattered light contained in the transmitted light is investigated. For registering strong blackenings the plate must be illuminated with diffuse light. Weakly blackened plates can be made harder and the disturbing effect of the gelatin can be avoided by dusting magnesia on the gelatin side of the plate and observing the plate with light incident on the glass side. J. E. K.

2970. Present Position of Fine Grain Emulsions. K. Fischer. *Zeits. f. wiss. Phot.* 31. 11. *pp.* 297–316, *April,* 1933.—Examines the question of fine grain emulsions by considering five main points. In dealing with the fine grain conditions by selection of suitable layers it is shown that the sensitivity of modern emulsions has been pushed almost to the theoretical maximum. Thus, the emulsion technique should make it possible to obtain the highest measure of fine grain condition with the highest sensitivity, rendering a further definite increase impossible. The efficiency of the present silver bromide plates is only 20 %, as 80 % of the incident light is either diffused in the layer or reflected. If the absorption can be increased to its maximum of 100 %, by sensitisation for example, then a plate with only one fifth of the present sensitivity could be used with a corresponding decrease in grain size. Hypersensitisation produces a small improvement of the fine grain conditions. This treatment is to-day the most useful method of increasing the fine grain condition by corresponding adjustment and if it were possible to increase the life of the photographic plates thus treated to one month and at the same time perform the hypersensitisation in the factory, then the question of the fine grain structure would be solved. Fine grain developers and methods of after-treatment have so far only produced an improvement of approximately 10 %, but it appears that an improvement of 100 % should be attainable. An important optical grain dissolution is made possible by the large aperture of the incident pencil of rays, the use of the method being simple and purely mechanical, consequently allowing the maximum grain solution to be obtained. R. C. F.

2971. Accurate Measurement of Photographic Density. P. Fleury and G. A. Boutry. *Comptes Rendus,* 196. *pp.* 1013–1015, *April* 3, 1933.—The use of a photoelectric cell in photometry [see Abstracts 200 and 1230 (1933)] is much facilitated by the use of a standardised wedge of grey glass which can be moved over the point at which the density is to be determined until the light passing through the combination is equal to that through a standard system, the change from the one system to the other being effected by means of a rotating nicol or a total reflection prism. In this way an optical density of 5 is measurable to an accuracy of 0·1 %. C. A. S.

2972. Precision Densitometer. G. A. Boutry. *Comptes Rendus,* 196. *pp.* 1101–1102, *April* 10, 1933.—Light is arranged to traverse either of two paths, one of which includes a fixed absorbing screen and the other of which includes the unknown screen and a screen of variable intensity. The emerging light is modulated by a rotating prism and falls upon a photoelectric cell. The current variations are then amplified. The process of measurement consist of adjusting the variable screen until the rectified output of the amplifier is independent of the path traversed. **Errata,** *ibid., p.* 1344, *May* 1, 1933. J. E. R. C.

2973. Textile Mutochrome. C. F. Smith. *Phot. J.* 73. *pp.* 191–197, *May,* 1933.—A description of the mutochrome as adapted for the application to designs of woven fabrics. The process is fivefold: (*a*) each element of the pattern is separately typed; (*b*) each part of the pattern is photographed separately to reduce its size; (*c*) the prints are placed in position individually on a screen and photographed successively by lenses in the front of the mutochrome; (*d*) after development the transparency is placed in its individual position on the mutochrome where it originally was found for photography in (*c*); and (*e*) colour filters are inserted and iris diaphragms secure different shades and intensities. A colour comparator is also described by means of which coloured yarns or cards can be compared by artificial daylight with the design under consideration. S. G. B.

See also Abstracts 2687, 3004, 3035, 3098.

PHOTOMETRY.

2974. Measure of Weak Light Flux with the Photoelectric Cell. E. Gambetta. *Comptes Rendus*, 196. *pp.* 906–908, *March* 27, 1933.—For measuring rapid variations of a weak light flux, a photoelectric cell is normally coupled to the first valve of an amplifier, by the aid of a high resistance, but there are various disadvantages in such an arrangement. The author describes a photoelectric measuring circuit in which the coupling " resistance " is formed by a vacuum tube with two carefully insulated electrodes and a filament. For a fixed average light flux, the filament current and the applied voltage in the circuit are adjusted to optimum conditions, and the variations of light flux are then proportional to the voltage developed across the electrodes of the vacuum tube. This voltage is transferred to the first amplifier valve, with the aid of a triode valve of " electrometer type." The arrangement described forms part of a photoelectric photometer. W. S. S.

2975. Photoelectric Cells for Daylight Measurement. H. H. Poole and W. R. G. Atkins. *Roy. Dublin Soc., Proc.* 20. *pp.* 537–546, *April*, 1933.—Describes the results of tests on six photoelectric cells of the " rectifier " type, *viz.*, an Auger CuO_2 cell with gold sputtered front surface, two similar cells made by the S.R.P.I. (France), a silver sputtered cell by Siemens-Halske, a Westinghouse red-sensitive cell, a Bergmann selenium rectifier cell. The illumination/current characteristics were found, and the spectral sensitivity curves. Temperature effects are important for some cells. Some cells of the Auger type show a small reverse effect in the red. The Bergmann cell is sensitive throughout the visible spectrum, the maximum being in the orange-red. It was the only cell of the six tested which maintained its sensitivity unaltered after prolonged exposure to daylight. J. W. T. W.

2976. Direct Recording of Relative Intensities by Means of a Microphotometer. N. Thompson. *Phys. Soc., Proc.* 45. *pp.* 441–444; *Disc.*, 444–446, *May* 1, 1933.—A description is given of an addition to the usual form of recording microphotometer, which gives a record on which ordinates are linearly proportional to light-intensities. Results are quoted to show that the performance of the instrument compares favourably with that of the unmodified form. AUTHOR.

See also Abstracts 2842, 2939, 2940, 2971, 2972, 3262.

POLARISATION.

2977. Alkali Tartrate Solutions Containing Chromium. J. P. Mathieu. *Comptes Rendus*, 196. *pp.* 1222–1224, *April* 24, 1933.—When the optical activity α, circular dichroism δ, and absorption of alkaline solutions containing for the same amount of chromic hydroxide increasing amounts of sodium tartrate are plotted against the amount of tartrate there are indications, besides the chromitartrate, $Na_2C_4H_4(CrO)O_6$ denoted as $Na_2(TCr)$, of the existence of one or more intermediate compounds and of another compound (B) for which α is negative in the blue and positive in the red, and δ is positive. If for the reaction $xM\mathrm{Cr(NO_3)_3} + xM\mathrm{Na_2C_4H_4O_6} + 3xM\mathrm{NaOH}$ δ is plotted against x, if x is $> 0\cdot8$, the intermediate compounds are shown to be absent, and only an equilibrium mixture of chromitartrate and (B) present: $\mathrm{TCr''} + (n-1)\mathrm{T''} \rightleftharpoons \mathrm{T_nCr}$; where n is probably 3. C. A. S.

2978. Studies in Solvent Action. Part VI. Optical Rotatory Powers of β-Octanol, *d*-Amyl Alcohol, and their Derivatives. H. G. Rule, Eleanora B. Smith and J. Harrower. *Chem. Soc., J. pp.* 376–387, *April*, 1933.—Previous work on the problem of solvent action [see Abstract 3699 (1932)] is now extended to a number of *sec.*-β-octyl and *d*-amyl derivatives, most of which are built up of a single polar substituent united to a simple optically active hydrocarbon radical. With octyl alcohol as active solute, the activity in aliphatic solvents decreases in general as the polarity increases, but in the aromatic series, marked irregularities from this sequence occur. The changes in rotatory power can, however, be attributed to changes in the electrical condition of the alcohol molecule in solution. For derivatives of octyl alcohol, there is also a definite tendency for solvents with low dipole moments to yield solutions of high activity and *vice versa*, except in the case of the chloride and bromide, where the reverse is true. The amyl derivatives may also be divided into two groups on the same basis, but there is no simple relationship between the variations of rotatory power here and those undergone by the corresponding octyl derivatives. In a review of the data so far available, four types of solute are pointed out and their behaviour discussed, but no definite generalisations can yet be attempted. C. B. A.

2979. Photographic Measurement of Very Weakly Elliptically-Polarised Light in the Ultra-Violet. G. Szivessy, A. Dierkesmann and C. Münster. *Zeits. f. Physik*, 82. 5–6. *pp.* 279–308, *May* 8, 1933.—A modification of the previously described method of measuring weak ellipticities [see Abstracts 3772 (1931) and 1589 (1932)] allows of measurements in the ultra-violet with sensitivity and accuracy comparable with those of the best methods for the visible spectrum. Simplicity of adjustment and freedom from disturbing internal reflections are achieved by the use of a single weakly doubly-refracting quartz plate, in combination with a linear analyser, and the sensitivity of the apparatus can be varied. The theory of the method is worked out in detail, and experimental procedure is outlined. Constructional details will appear elsewhere. C. B. A.

2980. Photoelectric Polarimetry. G. Bruhat and P. Chatelain. *Rev. d'Optique*, 12. *pp.* 1–20, *Jan.*, 1933.—A photoelectric polarimeter is described which is in principle a half-shadow instrument with a half-shadow angle of 90°. After passing through the optically-active substance, the polarised beam whose azimuth it is required to determine is divided into two components plane polarised at right angles by means of a doubly-refracting analyser. These two beams can be brought in turn into a photoelectric cell, and the orientation of the analyser for which they have equal intensities is determined. Details are also given of the amplifier (factor $= 10^6$) for the photoelectric currents, and of the ultra-violet monochromator, monochromatic light only being necessary for this method. The sources of error and the accuracy obtainable are discussed, and it is considered possible to measure a rotation of 45° with an error of only 0·25 %.

This precision has been obtained with the stronger lines of the mercury arc spectrum at 4358, 4046 and 3660 Å. [See also Abstracts 4933 (1932) and 204 (1933).] C. B. A.

2981. Photoelectric Polarimeter. G. Bruhat and A. Guinier. *Comptes Rendus*, 196. *pp.* 762–764, *March* 13, 1933.—Have improved the apparatus described by Bruhat and Chatelain [see Abstract 4933 (1932)] by extending the available radiation to 2481 Å and increasing the amplification of the photoelectric current. They used a Philips electrometer valve with a grid resistance of the order of 10^{-14} ohm when the grid potential was negative. The plate current of the second valve varied by 1 milliampere with a photoelectric current of $6 \cdot 10^{-14}$ ampere, and on measuring this variation with a ballistic galvanometer, through a transformer, it gave a deflection of 5 mm. The polarimeter is based on the half-shadow principle. Measuring the rotatory dispersion of saccharose, they obtained values with errors of 1 : 1000 down to 2950 Å, and 1 : 500 below 2950 Å.

E. E. F. d'A.

See also Abstract 3044.

RADIATION, EMISSION.

2982. Determination of the Constant σ of the Stefan-Boltzmann Law of Radiation. C. Müller. *Zeits. f. Physik*, 82. 1–2. *pp.* 1–36, *April* 22, 1933. *From the Reichsanstalt.*—This determination was undertaken at the suggestion of W. Nernst, since the newer values of σ differ by 1 %. A number of preliminary observations were carried out and the work and criticisms of the best known investigations in this field of work were carefully considered before the final form of the apparatus was determined. The work and suggestions of Kurlbaum, Ångström, Paschen, Gerlach and Warburg were very carefully noted. The method finally adopted consisted in allowing radiation from either of two black bodies of temperatures T_1 and T_2 to pass through a diaphragm of area F_1 and fall on a thin piece of metal foil of area F_2, blackened on both sides and of resistance w. This was at a distance R from the diaphragm. The temperature of the receiver (metal foil) was determined by a bolometer placed a short distance behind the receiver. An equal rise of temperature was afterwards obtained by passing an accurately measured current through the receiver. The value of σ was calculated from the expression $\sigma = J.E/[(T_1^4 - T_2^4).r^2.F^2.\alpha.\beta.\gamma/R^2]$, where J is the current through, and E the p.d. across the receiver, and r the radius of the (circular) diaphragm F_1. α is a correction factor for incomplete blackness of radiator and receiver, β a correction on account of absorption in the path between radiator and receiver, and γ a small correction factor due to the fact that all parts of F_1 and F_2 do not radiate perpendicularly to each other. The paper contains a number of diagrams showing the exact construction and arrangement of the essential parts of the apparatus. The difficulties encountered in the exact construction of the receiver are considerable and are minutely detailed. Thirty-seven sets of observations were made in all and the results are tabulated. The final value obtained for σ was $5 \cdot 774 \times 10^{-12}$ watt. cm^{-2}. $grad^{-4}$., with an estimated probable error of ∓ 0·02. T. B.

2983. Crookes Radiometer and the Intensity of Radiation. G. Russell. *Phil. Mag.* 15. *pp.* 997–1001, *May*, 1933.—The experimental data indicate that the rate of revolution of the vanes is directly proportional to the intensity of the incident radiation, this intensity varying inversely as the square of the distance of the source from the radiometer, and directly as the cosine of the angle of incidence. H. H. Ho.

2984. Action of the Earth's Magnetic Field on Penetrating Radiation. E. Fermi and B. Rossi. *Accad. Lincei, Atti.* 17. *pp.* 346–350, *March* 5, 1933.—The motion of an electrified corpuscle in the magnetic field of the earth has been studied by C. Störmer in connection with the problem of the Aurora Borealis. His theory is applied to the problem of the penetrating radiation on the hypothesis that the corpuscles that arrive on the earth are electrons, and the results of this calculation are compared with the experimental results of various recent observers. It is concluded that the results of the experiments hitherto carried out are, regarding the influence of the earth's magnetic field, in agreement with the hypothesis that the primary penetrating radiation is corpuscular. J. J. S.

2985. Mathematical Theory of the Average Action of Cosmic Radiation on Open or Protected Detection Apparatus. L. Tuwim. *J. de Physique et le Radium,* 4. *pp.* 138–163, *March,* 1933.—A detailed theory is deduced for cosmic incidences in two tube-counters with various orientations. Analytical expressions for the sensitivity of a system of two tube-counters are found, and illustrated diagrammatically for all cases. General expressions are found for a similar system, unprotected or in an enclosure of finite dimensions, for the number of collisions per unit time, and for the number of ions produced per unit time by cosmic radiation in a protected cylindrical ionisation chamber. N. M. B.

2986. Dependence on Latitude of the Intensity of Cosmic Radiation. W. M. H. Schulze. *Gerlands Beitr. z. Geophys.* 38. 3–4. *pp.* 353–356, 1933.—A short discussion of the question as to whether the intensity of cosmic radiation depends on the latitude, on which the conclusions of various observers differ. J. J. S.

2987. Absorption of Cosmic Radiation by the Atmosphere. E. Sevin. *Comptes Rendus,* 196. *pp.* 1005–1007, *April* 3, 1933.—Referring to his previous paper [see Abstract 211 (1933)] the author considers that experiment shows that there is a clear distinction between the agent which causes the appearance of ions and the agent which produces absorption. According to the undulating conception of the electromagnetic radiations these drag away and direct the particles. The extra-nuclear electrons torn from the atoms form progressively a regular secondary radiation which constitutes the agent causing absorption. The absorption of the cosmic radiation results from the bombardment and from the dislocation of the atoms by corpuscles which present individually identical mechanical characters. If there existed photons in the electromagnetic radiations, instead of manifesting itself progressively, the absorption of the cosmic radiation would commence suddenly, and the same would be the case if the primary radiation consisted of electrons of very great kinetic energy arising from the exterior of the atmosphere. This last view, as well as the hypothesis of photons, leads to suppositions which are not in accordance with the experimental facts. J. J. S.

2988. Absorption Curve of Ultra-Radiation and Its Explanation. E. Regener. *Phys. Zeits.* 34. *pp.* 306–323, *April* 15, 1933.—A summary account is given of the researches of the author and his coworkers in recent years on the cosmic radiation at the greatest possible heights in the atmosphere and at the lowest possible depths under water together with an analysis of the widely extending absorption curve obtained from the measurements. The chief sections of the paper deal with: (1) Measurements in Lake Constance, (2) Measurements in the stratosphere, (3) Consequences of the latter measurements, (4) Analysis of the absorption curve in water, (5) Analysis of the absorption curve in the atmosphere, (6) Explanation of the ultra-radiation itself. In discussing the interpretation of the radiation the author refers to the finding in it of about 5 different hard components whose discrete absorption coefficients lie within the interval 1 to 40. The two hardest components may with tolerable certainty be explained as wave radiation and their process of origin referred to the hypothetical occurrence provisionally called annihilation of helium and of the proton. The chief intensity of the soft portion lies in a component which may with qualifications be explained as of wave nature and may correspond to the formation of helium. For a corpuscular explanation of this or the remaining components there is almost no reason found from the analysis of the absorption. It is however not excluded. If the annihilation process is real then it is probably accompanied by corpuscular recoil rays. If the ultra-radiation comes from the vast regions of the universe then it will on its entrance into the earth's atmosphere bring with it corpuscular secondary radiation which it has liberated on meeting with cosmic dust. J. J. S.

2989. New Techniques in Cosmic-Ray Measurements. R. A. Millikan. *Phys. Rev.* 43. *pp.* 661–669, *April* 15, 1933.—A review of the results of recent methods of observation of cosmic rays. The first new technique referred to is that of C. D. Anderson in his measurements on the curvature of charged particle rays in a very powerful magnetic field. From various investigations two conclusions seem to be no longer controversial: (1) that the observed ionisation at sea level is due to charged particles, and (2) that certainly more than nine-tenths of these particles are secondaries formed in our atmosphere. The new electroscope technique with its freedom from temperature effects is referred to and the observations with self-registering instruments in aeroplanes which can hold the same level for long periods. Regarding the interpretation of the results of observation the author considers that the rapidly progressive softening of the rays with altitide is inexplicable on any charged particle theory as to the nature of the primary rays. J. J. S.

2990. Characteristics of the Penetrating Corpuscular Radiation at Sea-Level. B. Rossi. *Zeits. f. Physik,* 82. 3–4. *pp.* 151–178, *April* 29, 1933.—It is known that at sea-level the ultra-radiation phenomena are produced by a penetrating corpuscular radiation. An account is given of a series of researches undertaken with the object of obtaining a more accurate measurement of the mean penetrating capacity of this corpuscular radiation and an explanation of the secondary phenomena produced in matter. All the researches were carried out by the coincidence method, using Geiger-Müller counting tubes. The absorbability of corpuscular radiation was examined up to an absorbing thickness of 101 cm. Pb. Within the limits of accuracy this absorbability agrees with the measured absorbability of the total ultra-radiation. This is what must be expected if the primary ultra-radiation is itself a corpuscular radiation, but is very difficult to explain if the primary radiation is regarded as an ultra-γ-radiation. The existence of secondary particles in the matter passed through by the ultra-corpuscular rays was directly observed. The mean penetration capacity of these secondary particles was found to be of the order of magnitude of 1 cm. Pb. The most important peculiarities of this phenomenon and the influence of the secondary radiation on ultra-radiation phenomena were investigated. J. J. S.

2991. Origin of Cosmic Radiation. H. Alfvén. *Nature*, 131. *pp.* 619–620, *April* 29, 1933—In world space, single atoms will often pass in the neighbourhood of particles of matter and since the latter will always have energies considerably greater than the former, the single atoms will gain energy in each of these encounters. Simple considerations show that there will exist an exponential curve for the number of atoms as a function of their energy, in agreement with the experimental results of Kunze [see Abstract 1873 (1933)] on cosmic corpuscles. F. C. C.

2992. Direct Determination of the Natural Angular Distribution of Cosmic Rays. L. Tuwim. *Comptes Rendus*, 196. *pp.* 1431–1433, *May* 8, 1933.—The anisotropic distribution of cosmic rays must determine besides the effect produced by the rotation of a counting tube another directional effect depending on the length of the tube, its axis remaining fixed. If a parallel bundle of cosmic rays is parallel to the axis of a counting tube then the number of rays which traverse it is constant, whatever may be the length of the tube. If this bundle is perpendicular to the axis then the number of rays varies proportionally to the length of the tube. Thus from the nature of variation of the number of rays with the length of a counting tube it is possible to deduce the direction of the rays without turning the apparatus. The method proposed utilises simultaneously the two effects by causing to turn a system of different counting tubes. Thus by measuring with a great number of tubes in a great number of positions sufficient experimental data can be obtained to find with any degree of precision the angular distribution of the cosmic rays. The results of some observations carried out by this method are given. J. J. S.

2993. Use of Argon in the Ionisation Method of Measuring Cosmic Rays and γ-Rays. J. J. Hopfield. *Phys. Rev.* 43. *pp.* 675–686, *May* 1, 1933.—The saturation-voltage, current characteristics of argon were studied at two pressures of argon and at four widely different ionisation intensities produced by γ-rays. Pressure-ionisation curves for argon and for air were made. A comparison of the argon curve with the nitrogen one shows that argon is about twice as sensitive for use in ionisation chambers for studying γ-rays and cosmic rays. Some transient ionisation effects are described. A comparison of the intensity of cosmic rays to γ-rays was made and this ratio was found to be lower for argon than for air in the ionisation chamber at the same pressure. AUTHOR.

2994. Fluctuations of Cosmic-Ray Ionisation. J. W. Broxon, G. T. Merideth and L. Strait. *Phys. Rev.* 43. *pp.* 687–694, *May* 1, 1933.—The cosmic-ray ionisation in air contained at a pressure of 157·5 atmospheres in the 13·8 l. steel chamber surrounded by the 5·5–6 ft. water shield as previously described, was measured at four-hour intervals during a period of fifteen consecutive days, April 6–20, 1932. Controlled laboratory conditions and compensation features of the measuring equipment contributed to the constancy of measured ionisation values. By means of recording instruments, simultaneous records of the atmospheric potential gradient, the atmospheric temperature, the barometric pressure, and the relative humidity were also secured. It was determined that a decrease of 2·1 % in the cosmic-ray ionisation corresponded to an increase of 1 cm. in the barometric column. No correlation was established between the ionisation and the atmospheric potential gradient, the atmospheric temperature, or the absolute humidity. There appeared to be no regular diurnal variation of the ionisation either before or after the application of corrections for variations in barometric pressure. When deviations from the average of the ionisation values corresponding to a particular time of day were regarded as statistical fluctuations, the average probable error so calculated was 0·21 %. The greatest difference between the grand average and the average ionisation for a particular time of day was only about one-third of 1 %, less than twice the probable error. It seems very likely that the fluctuations observed were of a statistical nature. AUTHORS.

2995. Cosmic-Ray Intensities in the Stratosphere. I. S. Bowen and R. A. Millikan. *Phys. Rev.* 43. *pp.* 695–700, *May* 1, 1933. —Three flights which reached altitudes corresponding to the barometric pressures 79 mm., 32 mm., and 16 mm. of mercury respectively are reported. In two of these flights dependable electrometer readings down to pressure of 88 mm. and 61 mm., respectively, are obtained. These flights enable a ***weighted mean*** ionisation-altitude curve to be obtained down to a pressure of 61 mm. or 92 % of the way to the top of the atmosphere. The same shape of the ionisation-altitude curve is obtained from both flights and also from the flights made by Regener and by Piccard. This shape is concave downward at the top, *i.e.*, it shows a decreasing absorption coefficient as the top is approached. This indicates non-ionising primary entering rays not yet wholly in equilibrium with their secondary particle rays. The absolute values of the ionisation found in each of these two flights and on Regener's flight are in agreement within the limits of observational uncertainty. AUTHORS.

2996. Penetrating Radiation from Thunderclouds. B. F. J. Schonland and J. P. T. Viljoen. *Roy. Soc., Proc.* 140. *pp.* 314–333, *May*, 1933.—An arrangement for the study of the time relations between the impulses of a Geiger-Müller counter and the discharges of distant thunderclouds is described. The observations show that some of the counter impulses are systematically coincident with lightning flashes. These impulses and others occurring a few seconds before discharges take place are ascribed to a penetrating radiation emitted by the thunderclouds. The effects are not observed from storms distant less than 30 km. from the counter. AUTHORS.

RADIATION, GENERAL THEORY.

See Abstract 2788.

REFLECTION. REFRACTION AND DISPERSION.

2997. Reflective Power and Bireflection of Nickel Arsenide. W. Faber. *Zeits. f. Krist.* 85. *pp.* 223–231, *April*, 1933.—Observations parallel to (10$\bar{1}$0)and to (0001). Data for indices of refraction, absorption coefficients, and absorption indices for the following approximate wavelengths : 6560 Å, 5890 Å, 5270 Å. The index of refraction is calculated from the formula involving the reflective power of the substance in air and in cedarwood oil, together with the refractive index of the latter medium. F. I. G. R.

2998. Theory of the Representation of Errors of the Third Order. H. Schwerdtfeger. *Zeits. f. Instrumentenk.* 52. *pp.* 221–231, *May*, 1933.—The paper discusses the theory for the case of refraction at a spherical or other surface of revolution. The refraction is analysed by use of the eikonal and surfaces of the second and third order and of an infinite series are dealt with. The Gaussian system and the Seidel eikonal are discussed and the conditions required to obtain a solution of the equations for particular cases are indicated. W. D. W.

2999. Axial Chromatic Aberration in an Objective Lens. W. Herriott. *J.O.S.A.* 23. *pp.* 123–128, *April*, 1933.—The test object consists of five narrow transparent lines uniformly illuminated by monochromatic light obtained from a constant deviation spectrometer. An image is formed by the lens under test and then enlarged and projected by means of an apochromatic microscope objective on to a steeply inclined photographic plate. The position of the sharpest focus on the plate then indicates the position of the longitudinal focus for any wave-length. By moving the plate transversely a series of photographs for different wave-lengths can be recorded and the position of the various foci determined. In the apparatus described the lens under test was working at a magnification of 0·5. W. D. W.

3000. Refractive Indices of Solid Bodies. A. Biot. *Rev. d'Optique*, 11. *pp.* 481–500, *Dec.*, 1932.—A method of measuring the refractive index of a regular or irregular specimen is described in which the specimen is immersed in a liquid or mixture of liquids of suitable refractive index. The required index N is determined as the sum of two indices, n and Δn. n, the index of the liquid, is measured by the usual grazing incidence method and the small difference Δn between the liquid and the specimen is determined by an interference method employing a Fabry and Perot echelon. Apparatus designed on this basis is described, with details as to its use. It is found that indices can be determined to the fifth decimal place with even quite small specimens. W. D. W.

3001. Molecular Refraction of Alums. K. Wendekamm. *Zeits. f. Krist.* 85. *pp.* 169–198, *April*, 1933.—The K-, Rb-, Cs-, Tl-, NH_4-, NH_3CH_3- and NH_3OH-alums with (a) aluminium sulphate, (b) chromium sulphate, and (c) aluminium selenate (with the exception of the hydroxylamine alums) have been investigated and accurate measurements of their refractive index and density have been made. The results are tabulated systematically and the relations between the densities and indices for various groups of salts are shown graphically. Linear relations are found in most cases between the values for different groups as, for instance, when the densities of various selenates are plotted against the densities of the corresponding sulphates. The molecular volume, molecular refraction and the dispersion of the different salts are also analysed. W. D. W.

3002. Quantum Theory of Dispersion. Parts VI and VII. G. Breit. *Rev. Modern Physics*, 5. *pp.* 91–140, *April*, 1933.—A continuation of the discussion of the quantum theory of dispersion [see Abstracts 4229 and 4230 (1932)]. The aspects of the subject covered in this work are (1) phenomena near resonance and (2) coherent and incoherent radiation, and the range of validity of the theory. No new experimental results are presented and the paper is almost entirely mathematical in character. A. H.

3003. Artificial Rainbow. U. P. Lely. *Physica*, 13*e*. 3. *pp*. 83–85, 1933.—Dissolve 19 parts by volume of carbon tetrachloride in 100 parts of benzol. The resulting liquid has the same density as water, and is not soluble in it. Stirring vigorously in water gives therefore a suspension of droplets with which the phenomena of the rainbow can be imitated, especially as the refractive indices and dispersive powers are different. As many as three bows can be observed in sunlight or arclight. The second and third bow partly overlap. On looking with two eyes from a short distance two parallel bows are seen because each eye sees its own bow.
E. E. F. d'A.

See also Abstracts 2797, 2798, 2840.

SPECTROSCOPY.

3004. Infra-Red Spectra of Neon, Argon and Krypton. W. F. Meggers and C. J. Humphreys. *Bureau of Standards, J. of Research*, 10. *pp*. 427–448, *April*, 1933.—The first spectra of Ne, A and Kr have been photographed in the infra-red (7,600 to 12,200 Å) with two new Eastman emulsions having P and Q types of sensitisation with sensitivity maxima at 8600 and 9700 Å, respectively. The sources were Geissler tubes operated with uncondensed h.t. a.c. discharges, and the spectrographs were concave gratings of 21 ft. radius. About 200 infra-red lines have been photographed in the spectrum of each of the noble gases and analysis has resulted in the confirmation and extension of the tables of spectral terms. Several new hydrogen-like terms from *f*-type electrons have been found in each spectrum, and the 3d terms lacking in the AI and Kr I spectra have all been identified. Many of the new lines can be accurately computed from relative terms and such calculated values may serve as preliminary standards of wave-lengths in the infra-red. AUTHORS.

3005. Extension of the Pd I-Like Isoelectronic Sequence to Antimony VI and Tellurium VII. G. K. Schoepfle. *Phys. Rev.* 43. *pp*. 742–744, *May* 1, 1933.—With a vacuum spectrograph in the region 784 to 1331 Å some of the lines arising from the transition d^9p to d^9s electronic configurations of Sb VI and Te VII have been found. The wave-lengths and frequencies of the stronger lines are given along with the values for the sixteen terms $^3P^0D^0F^0$, $^1P^0D^0F^0(4d^95p)$ and ^3D, $^1D(4d^95s)$. Extrapolations were made from a Moseley diagram for the value of $^1S_0$, as the shorter wave-lengths (below 300 Å) for the $^1P_1{}^0$, $^3P_1{}^0$, and $^3D_1{}^0$ into $^1S_0$ were not obtained. Centroidal and fan type diagrams are also given. AUTHOR.

3006. Multiplets in the Spectra of Cb III and Mo IV. A. Y. Eliason. *Phys. Rev.* 43. *pp*. 745–748, *May* 1, 1933.—The Moseley law and, one of its consequences, the irregular doublet law are applied to the known data for the triads of quartets $^4FD^0$, $^4FF^0$, $FG^0(4d^3-4d^25p)$ and $^4FD^0$, $^4FF^0$, $^4FG^0$ $(4\,d^25s-4d^25p)$ in Yt I and Zr II to predict the position of the corresponding multiplets in Cb III and Mo IV. Nearly all of the terms in these two triads have been identified. Absolute term values for Cb III differ from those previously given. The lines were photographed with a 3m. concave grating, first mounted for normal incidence and later for grazing incidence. AUTHOR.

3007. Infra-Red Absorption Spectra of Halogen Derivatives of Methane. J. Lecomte. *Comptes Rendus*, 196. *pp*. 1011–1013, *April* 3, 1933.—Using a spectrograph with rotating prisms of rock-salt or sylvite the absorption spectra of the liquid halogen derivatives of methane have been determined for wave-lengths 6·9–20 μ. In most cases there are two maxima in good agreement with the Raman lines; the wave-lengths of both increase as the halogen changes from Cl to Br and thence to I; increase in the number of halogen atoms causes the wave-length of the maximum of greater wave-length to increase that of the less to decrease. Secondary zones of absorption are explicable by combination frequencies in the cases of the tri- and tetra-substituted derivatives. C. A. S.

3008. Absorption of the 1s-3d lines by Potassium. T. Okuda. *Tohoku Univ., Sci. Reports.* 22. *pp.* 9–12, *March*, 1933. *In English.*—Forbidden lines 1s-3d of potassium are observed in the absorption spectrum, and the influence of foreign gases on these lines is investigated.
AUTHOR.

3009. Rôle of the Absorption of the Exciting Ray in the Spectra of Resonance. W. Kessel. *Acta Physica Polonica,* 2. 1. *pp.* 91–95, 1933. *In French.*—By means of filtering and high dispersion with a Lummer-Gehrcke plate the absorption of the individual components of the Hg green line in tellurium and iodine vapours has been studied. Multiple excitation is indicated. J. E.

3010. Excitation of Atom Lines by Molecular Absorption in Cd Vapour. E. Kalinowska. *Acta. Physica Polonica,* 2. 1. *pp.* 111–117, 1933. *In German.*—The main purpose of the work is to decide whether the absorption of the molecules is a single or multiple process. The apparatus and method of observation are described for the determination of the relation between the exciting intensity and that of the emitted triplets. It is concluded that at low temperature the excitation is mainly in two steps, while at higher temperatures the single absorption process becomes more prominent, becoming almost the sole process at 850° C. It is difficult to account for the emission with single-process absorption, for the shortest line using the Al spark corresponds to an energy of 6·18 volts, while the excitation energy of the Cd atom for the transition from the normal state 1^1S_0 to 2^3S_1 is 6·35 volts. Two possible explanations are suggested: (1) the existence of a quasi-molecule in the Franck-Born sense, or (2) the occurrence of collisions of the second kind. Both suggestions involve the transfer of kinetic energy into transition energy so that either accounts for the increase of intensity with temperature. J. E.

3011. Distribution of Vibration Levels in Iodine Vapour. L. Natanson. *Acta Physica Polonica,* 2. 1. *pp.* 125–130, 1933. *In French.*—The author develops a previous idea for determining the distribution of vibration levels in a diatomic vapour by measuring the re-absorption of the resonance lines. It is shown that the concentration of molecules in a given state is given by $C = I - i/I$, where I is the incident light and i the transmitted light for the line concerned. The experimental results obtained using this method indicate that the concentration of a given state increases with the vibration quantum number to a maximum and then decreases, and that the maximum is displaced towards higher numbers with rise of temperature. J. E.

3012. Theory of the Breadth of Spectral Lines Using Correspondence Principle Methods. H. Casimir. *Zeits. f. Physik,* 81. 7–8. *pp.* 496–506, *March* 30, 1933.—Known results for radiation damping and the natural breadth of spectral lines are derived using the so-called Heisenberg method in which the amplitudes (non-commutative) of the electromagnetic potentials are used instead of their matrix elements, and the radiation emitted is derived with the aid of Maxwell's equations from the current and charge distribution. This procedure is also applied in the calculation of the natural breadth of a Raman line. W. S. S.

3013. Peculiar Structure of the Hydrogen Resonance Line 1216 Å. M. Kulp and H. E. Binkele. *Phys. Zeits.* 34. *pp.* 420–423, *May* 15, 1933.—In the h.f. discharge in helium containing a trace of hydrogen as impurity, the resonance line 1215·68 Å of hydrogen is observed to have a peculiar structure. On both sides of the main line there appear three or four subsidiary satellites symmetrically grouped at a distance of from 1·5 Å to 1·7 Å from one another. This satellite structure cannot be caused by diffraction effects, grating ghosts, Stark effect, hydrogen bands or lines of impurities; nor can the effect be ascribed to polarisation molecules of hydrogen with an inert gas or an impurity. The structure is not, however, easily reproducible; a high degree of purity of the discharge and a minute trace of hydrogen favour its appearance. A possible explanation of the structure is that it represents the transition $1s\sigma 3s\sigma\,{}^3\Sigma_g \rightarrow 1s\sigma 2p\sigma\,{}^3\Sigma_u$ of the hydrogen molecule but the precise symmetry of the structure presents a great difficulty to all attempted explanations. J. E. K.

3014. Isotope Displacement and Nuclear Moments of Zinc. H. Schüler and H. Westmeyer. *Zeits. f. Physik*, 81. 9–10. *pp.* 565–570, *April* 7, 1933.—The hyperfine structure of some Zn II lines is investigated. The observed structures can be interpreted as the resultant of a displacement effect of the lines of the three even isotopes, Zn^{64}, Zn^{66} and Zn^{68}, and a splitting of the line of the odd isotope Zn^{67}. From intensity and interval-rule considerations it is concluded that the nuclear moment of Zn^{67} is $I = 3/2$. J. E. K.

3015. Nuclear Magnetic Moments. S. Goudsmit. *Phys. Rev.* 43. *pp.* 636–639, *April* 15, 1933.—Various formulæ have been proposed for the determination of $g(I)$, the ratio of the magnetic to the mechanical moment of the nucleus, from observed hyperfine structure separations. In most cases these formulæ led to very different values of $g(I)$ when applied to the different levels of the same atom. Breit and Racah introduced relativity corrections into the formulæ for non-*s*-states but a discrepancy remained between the values of $g(I)$ obtained from non-*s*-states and those obtained from *s*-states. This discrepancy is greatly diminished by applying a relativity correction to the formula for *s*-states. The best approximate formulæ for calculating $g(I)$ from the separations of both *s*- and non-*s*-states are given and a table of values of $g(I)$, calculated for a number of elements from these formulæ, is appended. J. E. K.

3016. Paschen-Back Effect of Hyperfine Structure and Polarisation of Cadmium ($6^1P_1 - 5^1S_0$) Resonance Radiation. N. P. Heydenburg. *Phys. Rev.* 43. *pp.* 640–647, *April* 15, 1933.—The polarisation of Cd 2288 Å resonance radiation, excited by plane polarised light, changes from 76·7 % in zero field to 100 % in a strong field parallel to the electric vector of the exciting light, on account of the Paschen-Back effect of the hyperfine structure of the lines of the odd isotopes of Cd. The experimental results agree closely with calculations based on Goudsmit's modification of Darwin's theory of the Paschen-Back effect and give, for the separation of the two levels into which the 6^1P_1 level of Cd (odd-isotopes) is split, a value of $12 \cdot 6 \times 10^{-3}\,\mathrm{cm}^{-1}$. From this result and Schüler's measurement of the hyperfine separations of the triplet lines $6^3P_{0,1,2} - 6^3S_1$

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the constants of interaction of the p and s electrons are calculated from Goudsmit's equation. J. E. K.

3017. Spectra of Pb II, Hg I, Sb I, Cl II and I II. K. Murakawa. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 420. *pp.* 285–297, *April,* 1933. *In English.*—Investigation of the hyperfine structure of classified lines is a valuable aid to the identification of gross-structure terms. Thus with the aid of the hyperfine structure of λ5545 of Pb II the term $6s6p^4P_{5/2}$ of Pb II is identified. Similarly the term $5d^9 6s^2 6p^3P_0$ of Hg I is identified with the aid of the hyperfine structure of λ6123 of Hg I. Using the values of the nuclear moments of antimony found by Badami, $I = 5/2$ for Sb_{121} and $I = 7/2$ for Sb_{123}, the hyperfine structure of Sb I λ4033 is interpreted. Some further lines of the Cl II and I II spectra are classified. A probable value $I = 5/2$ for the nuclear moment of iodine is deduced from the hyperfine structure of some I II lines. J. E. K.

3018. " Prohibited " Rays due to Nuclear Spin. R. Einaudi. *Accad. Lincei, Atti,* 17. *pp.* 552–560, *April* 2, 1933.—Determines theoretically the intensity of rays of a bivalent element corresponding to the passage from $^1S_0$ to $^3P_2$ and $^3P_0$. These rays cannot be attributed to radiation either from a dipole or from a quadripole : they might be due to interaction of valency electrons with nuclear spin. The author has calculated the results to be expected on this last hypothesis, and has applied the data obtained to the lines 2270 and 2655 of mercury. A. D.

3019. Quantum Theory of Inelastic Electron Collisions. L. Goldstein. *Ann. de Physique,* 19. *pp.* 305–420, *April,* 1933.—The general theory of Born and Dirac is reviewed in relation to the uncertainty principle. The fundamental integrals of the energy matrix elements and the energy of binding between the incident electron and the atom are calculated, giving the probabilities of excitation of discrete levels of hydrogen-like atoms. From these results a detailed study is made of the excitation probabilities of levels of s, p, d and b series. The mechanism of the processes is shown to be in accordance with experimental results. A wave-mechanical determination of data for the evaluation of ionisation spectral levels is made.
N. M. B.

3020. Intensity Distribution in Spectral Lines Excited by Electron Impact. W. Heitler. *Zeits. f. Physik,* 82. 3–4. *pp.* 146–150, *April* 29, 1933.—If an atom is excited by its own resonance radiation it is known that the emitted radiation is identical with the incident light so long as the atom is not otherwise disturbed. Consequently, incident radiation which is monochromatic compared with the breadth of the emitted line will not excite the natural line but one which has the same form as the incident radiation. The author shows that a similar process must occur in excitation by impact of strictly homogeneous electrons. If the incident electron has a velocity corresponding to frequency ν_E, the form of the excited line depends upon the difference $\nu_E - \nu_0$ where ν_0 is the frequency corresponding to the maximum intensity of the natural line. If $\nu_E - \nu_0 \gg \gamma$ (the natural half width) then the emitted line has the form of the natural line and the same width ($= 2\gamma$). If ν_E lies within the natural half width, no frequency can be emitted $> \nu_E$ so that the line has a sharp onset on the short wave side at ν_E. Quantum mechanical calculations show that the intensity falls off slowly towards the long wave side. This only holds so long as the atom is undisturbed by the collisions. J. E. R. C.

3021. Probability of Excitation of Helium 2^1P at Zero Angle. J. E. Taylor and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 383–386, *April*, 1933.—Experiments were made on electron impacts, energies between 40 and 400 volts, with He atoms, the inelastically scattered electrons at zero angle being specially observed. It is found that for the 2^1P excitation : (1) the probability is very approximately a linear function of the energy of the incident electrons between about 40 and 400 volts energy ; (2) approximately the probability of excitation falls to zero at an energy somewhat greater than that corresponding to the critical excitation energy ; (3) the excitation probability is definitely lower than that predicted by the most recent theories. J. J. S.

3022. Lifetimes of Unstable Molecules. N. Rosen. *J. Chem. Phys.* 1. *pp.* 319–326, *May*, 1933.—The mechanism of the decomposition of a molecule formed by the collision between a molecule and another particle is discussed qualitatively. Calculations are then carried through to determine the lifetime of a simple linear triatomic molecule formed by the collision of an atom with a diatomic molecule. The results are applied to the short-lived molecule HO_2 to determine the order of magnitude of its lifetime in a number of different states, although it does not conform strictly to the idealised conditions for which the calculation was made. AUTHOR.

3023. Band Spectrum of Potassium Hydride. T. Hori. *Ryojun Coll. Eng., Mem.* 6. 1. *pp.* 1–33, *March*, 1933. *In German.*—The band spectrum of potassium hydride between 4090 and 6610 Å is photographed with a grating of 2 m. radius, using as source a potassium arc in hydrogen. The results are similar to those of Almy and Hause [see Abstract 241 (1933)], but the data are more extensive and the accuracy is claimed to be higher. Analysis reveals sixty-two bands which may be arranged in five v'-progressions. Each band consists of P- and R-branch and corresponds to a $^1\Sigma$–$^1\Sigma$ transition. The anomalous behaviour of the rotational constant B_v' and the vibrational interval ω_v' of the upper state, as observed by Almy and Hause, is confirmed. The results indicate that the normal molecule dissociates into a K-atom and an H-atom, both in the ground state ; while the excited molecule gives an excited ^2P K-atom and a normal H-atom. The dissociation energies obtained for the normal and excited molecules are respectively 1·91 and 1·15 (± 0·1) volts. On the short-wave side of the discontinuous spectrum is found a continuum with maxima at 3920, 3750 and 3500 Å. L. A. W.

3024. Mercury Bands Associated with the 2482·07 Å Line. L. Job. *Acta Physica Polonica*, 2. 1. *pp.* 31–37, 1933. *In German.*—Four band heads have been observed in the spectrum of a special form of mercury arc, and the values obtained compared with those of Rayleigh and Brzozowska. The value of the ions concerned is discussed. F. S.

3025. Spectrum of Hydrogen Sulphide. N. O. Stein. *Astrophys. J.* 77. *pp.* 270–273, *May*, 1933.—The emission spectrum of H_2S was investigated by means of a valve oscillator, the circuit of which is described in detail. No spectrum characteristic of H_2S was observed, the gas giving the Balmer series, the hydrogen secondary spectrum and the continuous spectrum, along with a group of diffuse bands extending from about 2470 Å to 2860 Å. Carbon disulphide shows the same bands when excited under similar conditions and they are therefore ascribed to sulphur. The wave-lengths of these bands are given in a table. AUTHOR.

3026. Infra-Red Absorption Spectra of Certain Alkaloids. M. E. O'Byrne. *J.O.S.A.* 23. *pp.* 92–100, *March*, 1933.—The absorption spectra of twelve alkaloids were examined between 1·00 μ and 12·00μ using constant deviation spectrometers with fluorite and rock-salt prisms. The compounds investigated were α-β-dipyridyl, anabasine, neo-nicotine, methyl anabasine, nicotine, spartine, spartine sulphate, pelletierine, arecoline, arecoline hydrobromide, pilocarpine, and pilocarpine hydrochloride. Anabasine and neo-nicotine are presumably the same alkaloid, anabasine being a plant extract and neo-nicotine a synthetic product. They show, however, different absorption characteristics. Absorption bands corresponding with the C-N, C-H, $C\text{-}H_2$ and benzene ring frequencies are present.
W. R. A.

3027. Infra-Red Spectrum of Carbon Dioxide. Part I. A. Adel and D. M. Dennison. *Phys. Rev.* 43. *pp.* 716–723, *May* 1, 1933.—Previous work by Fermi and by Dennison has shown that the principal features of the infra-red and Raman spectra of CO_2 may be explained by taking account of the first order perturbation terms in the potential energy expression. It was not possible to predict the positions of the levels with any high degree of accuracy, however. The present paper extends this work by introducing a second order perturbation. The formula for the second order energy correction of a general linear symmetrical triatomic molecule is initially computed. This formula is then modified in order that it may be applicable to the CO_2 molecule in which resonance degeneracy plays an essential rôle. A review is made of the experimental data which determine the positions of the CO_2 vibrational energy levels. These include the results of a recent investigation of absorption bands appearing in the spectrum of Venus, as well as new and as yet unpublished data found by Barker and Wu. In all, twenty levels have been found and out of these, eleven are required to determine the anharmonic constants of the molecule. The remaining nine levels may then be predicted, and their positions are found to agree very accurately with the values obtained experimentally. A table is given showing the positions of a number of CO_2 infra-red bands which while accessible to observation have not as yet been reported. The recent work by Langseth and Nielsen on the Raman spectrum of CO_2 is discussed.
AUTHORS.

3028. Ultra-Violet Absorption Bands of Ammonia. J. K. Dixon. *Phys. Rev.* 43. *pp.* 711–715, *May* 1, 1933. The ultra-violet absorption bands of ammonia have been investigated in the region from 2400 to 1900 Å over a wide range of temperatures and pressures. The frequencies of a number of intense double-headed bands have been measured and an analysis of these bands is presented. The doublet separation is nearly constant and is equal to 70 cm.$^{-1}$. Only two fundamental frequencies are observed in the upper state, namely, 890 and 2720 cm.$^{-1}$. The predissociation which occurs in the excited state is discussed and accounted for by assuming that the $v_2'(\perp)$ type of vibration of the molecule is always unstable.
AUTHOR.

3029. Regularities amongst Hydrides. A. Krebs. *Zeits. f. Physik*, 81. 11–12. *pp.* 776–780, *April* 18, 1933.—An equation is proposed for the nuclear distance-atomic number curve for the hydrides of the elements from Li to F. The curve appears to consist of two different parts, one for the elements Li to B and the other for the elements C to F. Nuclear distance is also plotted against atomic number for the hydrides of the elements of the different periods and groups of the periodic table, and reference is made to the possibility of calculating constants for RbH and CsH. L. A. W.

3030. Spectroscopic Events in the Explosion Zones of Methane and other Hydrocarbons. F. J. Lauer. *Zeits. f. Physik*, 82. 3–4. *pp.* 179–191, *April* 29, 1933.—Spectroscopic data are obtained from methane-oxygen explosion mixtures, and a comparison made with data from acetylene-, and benzene-oxygen mixtures. In the active explosion zones of methane, the CH- band at 3143 Å was established, this band not having been identified hitherto in flames and explosion zones. The bands which T. Hori [see Abstract 653 (1930)] obtained in the arc between carbon and tungsten electrodes in a hydrogen atmosphere have been found in the active explosion zones of oxygen and illuminating gas, and are especially well-defined in acetylene. In addition to the known –OH, –CH, and C_2-spectra, a further hydrocarbon band CH_2 has been found at 3672 Å in the active explosion zone of methane and its order discussed. A reaction scheme for the methane-oxygen explosions is based on the above data. H. H. Ho.

3031. Interpretation of the Spectra of Polyatomic Molecules. L. Tisza. *Zeits. f. Physik*, 82. 1–2. *pp.* 48–72, *April* 22, 1933.—The symmetrical properties of the harmonic and combinational vibrations of polyatomic molecules are investigated with the aid of group theory, and the theoretical term schemes of the vibration spectrum are derived for all possible symmetries. The rotation structure is also considered, and the selection rules are given both for the infra-red spectrum and for the Raman spectrum. J. E. K.

3032. Energy of Short-Lived Atomic Encounters. W. Kuhn and H. Martin. *Zeits. f. Physik*, 81. 7–8. *pp.* 482–490, *March* 30, 1933.—The determination of the energy with which the parts of a molecule come together is considered for the case in which they are separated by monochromatic light in the pre-dissociation field where the frequency is sharper than the widened absorption line. It is concluded that the energy is large although the life of the molecule is small. This is contradictory to thermodynamics, but is an inherent difficulty in quantum conceptions. F. S.

3033. Normal State of the Hydrogen Molecule-Ion. B. N. Dickinson. *J. Chem. Phys.* 1. *pp.* 317–318, *May*, 1933.—A variation function somewhat similar to that applied by Rosen [see Abstract 1509 (1932)] to H_2 is used in the discussion of the normal state of H_2^+. AUTHOR.

3034. Effect of Helium on the Continuous and Secondary Spectra of Hydrogen. A. S. Roy. *Nat. Acad. Sci., Proc.* 19. *pp.* 441–444, *April*, 1933.—An examination is made of the continuous and secondary spectra of hydrogen as observed in varying mixtures of hydrogen and helium. It is found that, in general, the addition of helium to hydrogen produces an increase of intensity of the lines of the triplet system relative to those of the singlet system; the continuous spectrum also becomes much stronger. The phenomena are accounted for in terms of the limitation of electron velocities by the helium, which would increase the probability of exciting the triplet states of hydrogen. A. H.

3035. Continuous Absorption Spectrum of Polyatomic Molecules. Y. Hukumoto. *Tohoku Univ., Sci. Reports,* 22. *pp.* 13–30, *March,* 1933. *In English.*—An extension of earlier work [see Abstract 1904 (1933)] on halogen alkyls. The effect of foreign gas on the absorption spectra is investigated, and experiments are carried out on the relation between the absorption limit and the pressure and length of the vapour column. The absorption spectra of the halogen alkyls in the liquid state are also examined and appear to be much the same in the two states. The absorption spectra of these compounds are exactly similar, except that, in the order Cl,-Br,-I, the absorption regions are displaced towards the long-wave region. The upper limit of the heat of dissociation of the carbon-halogen linkage is estimated from the absorption edge in each case, and, finally, the probable mechanism of the photo-dissociation process of the halogen alkyls is considered. AUTHOR.

3036. Distribution of Energy in the Fluorescence Bands of Mercury Vapour. I. Mrozowska. *Acta Physica Polonica,* 2. 1. *pp.* 81–89, 1933. *In French.*—By excitation with the line 2558 of the zinc spark bands alone are excited and no lines. At 360° C. an increase of pressure from 85 mm. to 658 mm. increased the ratio of intensity of band 4850 to 3350 by 23 times. This ratio of intensities decreased 800 times, when at a pressure of 157 mm. the temperature was increased from 300° to 510° C. J. E.

3037. Action of a Magnetic Field on the Absorption Lines of I_2. I. I. Agarbiceanu. *Comptes Rendus,* 196. *pp.* 760–672, *March* 13, 1933. —With an echelon spectrograph, and observing a quartz mercury arc at right angles to a field of 14,000 gauss, the author has found a distinct broadening and intensifying of the space between the lines designated by Wood as 3 and 4, seen with a high dispersion against the dim background of the green mercury line. In addition, there is a slight increase of absorption on the more refrangible side of 4, which explains the extinction of the fluorescence of iodine in the magnetic field. Traces of oxygen seem to counteract the magnetic field in this case. E. E. F. d'A.

3038. Stark Effect. E. U. Condon. *Phys. Rev.* 43. *pp.* 648–654, *April* 15, 1933.—The theory of the Stark effect in atomic spectra is discussed in general terms and it is shown that large effects arise when two terms which are related to each other in such a way as to satisfy the optical combining rules come close together in the spectrum. Fairly good values of the Stark displacements in complicated atoms may be obtained simply by using the hydrogenic values of the matrix components involved in the theoretical formulæ. The ideas are illustrated by discussion of the existing data on the spectra of nickel, lithium, carbon spark and argon. AUTHOR.

3039. Rotation Structure of the Raman Bands of Polyatomic Molecules. G. Placzek and E. Teller. *Zeits. f. Physik.* 81. 3–4. *pp.* 209–258, *March* 11, 1933.—The intensity distribution in the pure rotation and oscillation-rotation Raman spectra of polyatomic molecules is derived using the " polarisability " theory already employed by Placzek in computing the total intensity of the Raman lines corresponding to a single oscillation transition. Taking as molecular model, the symmetrical top, the linear rotator and the spherical top, the theory is worked out completely. For the more complicated case of the asymmetric top, the selection rules are alone given. The results make possible deductions from the rotation structure of oscillation bands as to the symmetry properties and ordering of the oscillations. If the oscillation possesses a resultant rotational momentum, the rotation structure is modified by coupling between oscillation and rotation, and this leads to the determination both of the moments of inertia and the oscillation form. The expected rotation and oscillation rotation structure for molecules of the most important types is discussed in connection with such experimental data as are available. W. S. S.

3040. Raman Spectrum of Gaseous Ammonia. E. Amaldi and G. Placzek. *Zeits. f. Physik*, 81. 3–4. *pp.* 259–269, *March* 11, 1933.—Observations on the Raman spectrum of gaseous ammonia using as exciting radiation the mercury line 2537, gave a completely resolved Raman pure rotation spectrum of 21 lines containing besides O and S branches ($\Delta J = \pm 2$), also P and R branches ($\Delta J = \pm 1$), as indicated by theory for non-linear molecules. The intensity distribution within the rotation spectrum was found to agree qualitatively with that derived from the theory of Placzek and Teller [see preceding Abstract]. Besides the rotation spectrum, several new oscillation lines were observed, in particular a doublet corresponding to the 10μ band, the separation of which is connected with the two possible equilibrium positions of the nitrogen nucleus. The spectrum of liquid ammonia is also briefly discussed. W. S. S.

3041. Raman Spectra of Alkali Metal Nitrates. H. Nisi. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 114–124, *March,* 1933. *In English.*—The Raman spectra of alkali-nitrates, including $RbNO_3$ and $CsNO_3$, were examined in single crystals and also in their aqueous solutions. In crystals, the frequency shift corresponding to the inactive vibration of NO_3-group does not decrease with the increase of atomic number of the kation. This will imply that the frequency shift depends not only on the atomic number of the kation, its valency and the amount of water of crystallisation, but on the crystal system to which a crystal belongs. Some new lines were observed, which had not been found by using the specimen in powder form. On the other hand, in the aqueous solutions, the frequency shift seems to decrease very slowly with the increase of atomic number of the kation. The Raman spectra of calcite and aragonite were obtained for comparison with those of $NaNO_3$ and KNO_3 respectively. Nitrates behave in a similar manner to carbonates, though not in minor detail. AUTHOR.

3042. Raman Effect in Glycerin. R. Bär. *Zeits. f. Physik,* 81. 11–12. *pp.* 785–789, *April* 18, 1933.—Fifteen lines, compared with seven previously found, in the Raman spectrum of glycerin are tabulated and discussed. The author's investigations show that, contrary to the conclusion of Carrelli and Went [see Abstract 1516 (1933)], the continuous part of the spectrum is attributable to fluorescence and is not in part a Raman effect. J. S. G. T.

3043. Raman Spectra of Monobasic Organic Acids. K. W. F. Kohlrausch, F. Köppl and A. Pongratz. *Zeits. f. phys. Chem.* 21. *Abt.B.* 3. *pp.* 242–255, *May,* 1933.—The Raman spectra of 16 fatty acids, R. COOH, are recorded, including the 10 normal acids from formic to decylic acid, and in addition the spectra of the mono-, di-, and trichloroacetic acids and of benzoic acid. From the changes in intensity of the lines with alteration in chain length, it is concluded that the characteristic frequencies $\Delta\nu = 1650, 1410, 110\ \text{cm.}^{-1}$, for the normal acids belong to oscillations of groups which only occur singly in the molecule, while the frequencies 1450 and 1300 belong to groups whose number in the molecule increases proportionally with the chain length. The carbonyl-frequency 1650 exhibits a weak but distinct depression with increasing ramification of the chain in α-position. H. H. Ho.

3044. Depolarisation of Light Scattered by a Uniaxial Crystal when the Optic Axis and the Scattered Ray are Parallel. J. Cabannes. *Comptes Rendus*, 196. *pp*. 977–979, *April* 3, 1933.—All the Raman lines of a uniaxial crystal when the axis is orientated along the direction of scattering are completely depolarised (*e.g.*, the 1087 cm.$^{-1}$ line of CO_3 in calcite and the 1074 cm.$^{-1}$ line of NO_3 in sodium nitrate). The experimental facts cannot be explained on the basis of the Langevin molecular model, but a correct explanation is now derived from the Kramers-Heisenberg equation. C. B. A.

3045. Recording Infra-Red Quartz Spectrograph. J. W. Ellis. *Rev. Sci. Instruments*, 4. *pp*. 123–127, *March*, 1933.—The new instrument has been constructed to replace the spectrograph previously described [see Abstract 713 (1926)]. The optical parts have been chosen to give increased resolving power and are all housed in a metal casing. Complete constructional details are given. Absorption curves for atmospheric water vapour and for ethylene and methylene bromides are recorded and compared with previous results. The range of the instrument is $0{\cdot}7\mu$ to $2{\cdot}7\mu$. W. R. A.

3046. Multiple Prism Glass Spectrograph. D. H. Rank. *J.O.S.A.* 23. *pp*. 84–87, *March*, 1933.—Constructional details are given of a new spectrograph combining the following characteristics: (1) it can be used to solve nearly every problem requiring the use of a glass prism spectrograph; (2) it has a resolving power and dispersion comparable to a 21-ft. grating with the advantage of being free from ghosts; and (3) it is mounted so that more than 20 combinations are available by simple adjustments, thus giving a wide range of photographic speeds and dispersion. W. R. A.

3047. Focus of a Concave Grating Spectrograph. D. L. MacAdam. *J.O.S.A.* 23. *pp*. 178–181, *May*, 1933.—The problem of mounting a 21-ft. concave grating and slit at oblique incidence, so that the focus will lie on a previously established track having less than one inch adjustment range, is discussed. A simple technique, employing only a good transit, is described. The development of this method depends on a precise knowledge of the nature of the general focal curve. This information is found by a brief examination of grating theory. A table of permissible departures of the slit from the Rowland circle is given, such that the error in path length to the sharpest image is less than λ/4. Application of classical grating theory to the case of oblique incidence and diffraction results in an expression for maximum useful grating width. This expression is shown to differ only by a factor of 1·06 from the expression derived in a recent article by Mack, Stehn and Edlén [see Abstract 3712 (1932)]. AUTHOR.

3048. Theory of Concave Grating Spectrograph, Especially at Large Angles of Incidence. J. E. Mack and J. R. Stehn. *J.O.S.A.* 23. *pp*. 184–185, *May*, 1933.—A graph is given from which the optimum width of a concave grating may be found for any practical case. [See Abstract 3712 (1932).] AUTHORS.

3049. Experimental Investigation of Grating-Ghosts. W. Rudolph. *Zeits. f. Physik,* 82. 5–6. *pp.* 372–396, *May* 8, 1933.—The ghosts given by five Rowland concave gratings are photographed and measured. Calculation shows that four of the gratings (all ruled with Rowland's third machine) have an error period of 750 lines, while the fifth (ruled with Rowland's second machine) has an error period of 1000 lines. These numbers correspond to the numbers of teeth on the spacing wheels of the respective ruling machines. Use is made of these error periods to point out numerous ghosts mistaken for independent lines in published work carried out with the gratings in question. L. A. W.

3050. Some Infra-Red Interference Spectra. J. W. Ellis. *J.O.S.A.* 23. *pp.* 88–91, *March,* 1933.—Numerous interference maxima and minima are found to be regularly superimposed upon the continuous spectra of cellophane and mica in the region $0\cdot7\mu$–$2\cdot7\mu$. Interference maxima are obtained when the equation $2\mu t \cos r/\lambda = \mathrm{N}$ is satisfied, where μ is the refractive index, t the thickness, r an average angle of refraction within the specimen, and N an integer. If μ is assumed constant, this equation becomes $\mathrm{N} = -(\lambda/\Delta\lambda)\Delta\mathrm{N}$, and an assignment of N to the various maxima can be made without knowing the thickness or the refractive index of the specimen. W. R. A.

See also Abstracts 2797, 2948, 2959, 3111, 3112, 3113, 3176.

VISION.

3051. Binocular Oscillation and Fusion of Colours. J. F. Allen. *Canad. J. of Research,* 8. *pp.* 390–400, *April,* 1933.—When pairs of colours fall upon the same area of a retina it is impossible to separate the receptor actions in the retina from those that take place in the visual centres of the cortex. If the separate colours, however, are allowed to fall upon the two eyes, the fusion colour effects must be attributed to the sensations in the cortex. In this investigation the binocular fusion of complementary colours into white is confirmed, as well as the binocular fusion of red and green colours into yellow. The sensation of yellow is therefore proved to be compounded of the fundamental sensations, red and green. The binocular oscillation or rivalry of colours was specially studied and shown to be due not to fluctuations of attention, but probably to the oscillation of the neural processes of inhibition and facilitation. The oscillation of colours is thereby connected with other phenomena of vision. AUTHOR.

3052. Visibility of Objects Illuminated by a Projector. Part II. Y. Rocard. *Rev. d'Optique,* 11. *pp.* 439–457, *Nov.,* 1932.—Using the results of Part I [see Abstract 4214 (1932)] the visibility is calculated for a concrete case, full details being given. A general formula is then derived to represent the minimum perceptible brightness contrast γ of an object with its surrounds, in terms of the brightness e of the latter and the angular size θ of the object :

$$\frac{e}{1+1\cdot16\,e}=\frac{0\cdot014\,\dfrac{0\cdot005}{\theta}\left[1+\dfrac{0\cdot005}{\theta}\right]}{\gamma-0\cdot015}.$$

The brightness contrast γ is defined as $\Delta e/e$ where Δe is the brightness difference between object and surrounds. It is believed the formula is approximately valid in the range $e = 10^{-4}$ to 10^{+4} equivalent lux. The variation in the visibility of an object placed in different parts of the beam is then discussed. Finally, field observations on the maximum range of searchlights are used to derive a relation between e, θ and γ which does not differ much from the above formula based on laboratory researches.

W. S. S.

3053. Visibility of the Ultra-Violet down to a Wave-Length of 3130 Å. J. Saidman. *Comptes Rendus*, 196. *pp.* 1537–1539, *May* 15, 1933.—The author describes a special filter which transmits radiation in the range 2650 Å to 3341 Å. On viewing various light sources through this filter, a lavender-coloured halo due to fluorescence of the lens of the eye is observed and, in addition, for not too elderly subjects, the image of the light source can be seen. The colour of the image is violet or bluish depending on the brightness of the source in the range of the spectrum concerned. By interposing other filters it was shown that the image of the source arises from radiation in the range 3130 to 3022 Å. Tests on 102 subjects showed that ability to see the rays at about 3100 Å, is lost at some age lying between 34 and 43 years. It follows that the crystalline lens cannot be so opaque to the ultra-violet as previously supposed, at any rate up to a certain age of subject. W. S. S.

3054. Visual Acuity and Sodium Light. M. Luckiesh and F. K. Moss. *Frank. Inst.*, *J.* 215. *pp.* 401–410, *April*, 1933.—The authors determined the visual acuities of nine subjects, using a square test object of 0·6° side and made up of dark bars on a bright background, (*a*) when the background brightness was of monochromatic sodium light and (*b*) when the background brightness was heterogeneous light from a tungsten filament lamp. The subject's eyes were dark-adapted, and apart from the test object the field was totally dark. For background brightnesses in the range 0·02 to 20 millilamberts, the sodium light gave a somewhat greater acuity than the white light, the difference varying from 8 % at 20 millilamberts to 24 % at 0·02 millilambert. Measurements of pupil diameter failed to show any difference for a given brightness of sodium light or white light. W. S. S.

X-RAYS.

3055. Scattering of X-Rays from Powdered Crystals. G. E. M. Jauncey and F. Pennell. *Phys. Rev.* 43. *pp.* 505–515, *April* 1, 1933.—A tungsten X-ray tube is operated at 54·9 kV and a beam containing a wide band of wave-lengths is obtained by passing the X-rays through 3·25 mm. of Al. The scattered intensities at average angles from 5° to 90°, from powdered crystal brickettes of KCl, CaS, NaF and MgO, are compared with the scattered intensity at 90° from paraffin, using a " wide " window ionisation chamber of extreme angular width 6°. From Jauncey and Harvey's theory of the diffuse scattering from crystals, together with the theory of the Debye-Scherrer circles, a formula is deduced for the ionisation current produced by the rays entering a narrow window and consisting of a wide band of wave-lengths of known intensity distribution. This formula is integrated graphically to apply to the case of a wide window. The calculation of the theoretical values involves values of f and f″, both of which were obtained from a wave-mechanical treatment of James and Brindley. Excellent agreement between the theoretical and experimental values of the scattered intensity is obtained and it is shown that an average wave-length as determined by absorption in Al may be approximately treated as if it were a single wave-length and so the S-curves obtained for KCl by Harvey and for NaF by Jauncey and Williams, are reasonably accurate. F. C. C.

3056. Diffuse Scattering of X-Rays from Sylvine. Part II. G. G. Harvey. *Phys. Rev.* 43. *pp.* 591–595, *April* 15, 1933.—The absolute intensity of the diffuse scattering of X-rays of wave-length 0·71 Å from sylvine has been measured for a range of angles from 5° to 110°. Homogeneous radiation obtained by the use of balanced filters was used. Woo's formula taking account of the incoherence of part of the scattering was used to calculate the average atomic structure factors of the ions K^+ and Cl^-. The results are in good agreement with Wollan's values for argon as well as the theoretical values calculated from a Schrödinger charge distribution by Hartree's method. [See Abstract 139 (1932) and following Abstract.] AUTHOR.

3057. Diffuse Scattering of X-Rays from Sylvine. Part III. Scattering at the Temperature of Liquid Air. G. G. Harvey. *Phys. Rev.* 43. *pp.* 707–710, *May* 1, 1933.—This paper is an extension of previous work [see preceding Abstract] on the diffuse scattering of homogeneous X-rays from sylvine. Measurements have now been carried out at the temperature of liquid air. It is found that taking into account uncertainties in the measurements of both the diffuse scattering and regular reflection the formula $S = (f^2 - F^2)/Z + (1 - f^2/Z^2)/(1 + \alpha \operatorname{vers} \phi)^3$ probably accounts for the intensity of the scattering within the limits of experimental error for the range of temperature used. AUTHOR.

3058. Coefficients of Absorption of X-Rays in the Neighbourhood of L-Edges. M. Wolf. *Ann. d. Physik,* 16. 8. *pp.* 973–984, *April,* 1933.—From the measured absorption-coefficients are deduced the numbers of dispersion electrons in the three L- levels for Ag, Au, and Pt. When we pass from Ag to Au-Pt, the continuous absorption in the L_{II} level increases, while that in the L_{III} level falls off. This alteration runs parallel with an alteration in the emission-spectrum; the L- lines pertaining to the L_{II} increase, while those pertaining to the L_{III} fall off. A. D.

3059. Influence of Temperature on the Röntgenisation of Rock-Salt. C. Sinelnikow, A. Walther, I. Kurtschatow and S. Litwinenko. *Phys. Zeits. d. Sowjetunion,* 3. 3. *pp.* 262–267, 1933.—The effect of X-rays on crystals of rock-salt at various low temperatures (− 180° C.) gave almost no yellow coloration and no inner photoelectric effect. A theory is proposed to account for the latter phenomena. H. H. Ho.

3060. Effect of Strain on Intensity of X-Ray Reflection. E. Fukusima. *Hiroshima Journ. Sci.* 3. *pp.* 177–185, *March,* 1933. *In English.*—The intensity of reflection of Mo $K\alpha$ radiation transmitted through a crystal in a state of strain is measured by means of a Bragg X-ray spectrometer. It is found that in the case of a perfect crystal, quartz, the intensity of the reflected beam increases to a marked degree with the strain, but that in the case of an imperfect crystal, rock-salt, the effect is very small. Laue photographs are also taken. The increase of intensity is interpreted as being due to the reduction of extinction by the strain. J. T.

3061. Total Reflection of X-Rays by Liquids. H. Steps. *Ann. d. Physik,* 16. 8. *pp.* 940–972, *April,* 1933.—An investigation into the total reflection of monochromatic X-rays by the free surface of various liquids, including mercury and solutions of various concentrations. Comparison with previous results, and theoretical discussion. A. D.

3062. Total Reflection of X-Rays by Thin Layers. A. I. Alichanow and L. A. Arzimovič. *Zeits. f. Physik,* 82. 7–8. *pp.* 489–506, *May* 15, 1933.—Measurements of the total reflection of X-rays by vapour-deposited layers of metals of various thicknesses upon underlying material. Experiments were made upon Ag and W layers on glass, Ag layers on aluminium (in which cases the refractive index of the deposited layer was smaller than that of the underlying substance), Al layers on silver, Ag layers on platinum and tungsten (in which cases the refractive index of the deposited film is the greater). Experimental details and a theoretical treatment of the subject are given. Experiment and theory are in harmony. A. D.

3063. Absolute X-Ray Reflectivities of Single Crystals of Calcite, Rock-Salt, Rochelle Salt and Barite. P. Kirkpatrick and P. A. Ross. *Phys. Rev.* 43. *pp.* 596–600, *April* 15, 1933.—With a two-crystal spectrometer absolute X-ray reflectivity measurements have been performed upon four different crystals. In the case of a large calcite crystal of uniform appearance, considered a good spectrometer crystal, with Kα radiation of silver it is found that the theoretical values of percent reflection, integrated reflection, and rocking curve width calculated by Allison on the basis of the Darwin-Prins theory of reflection by a perfect absorbing crystal are not attained, the experimental and theoretical quantities being related by a factor not far from two in each case. Rock-salt crystals from a large exhibition specimen from Russia were found to be much more perfect in structure than any rock-salt specimens heretofore reported in the literature of X-ray spectrometry. Rock-salt reflectivity data for Ag Kα are given. Artificial Rochelle salt crystals are found to possess rocking curve widths as narrow as those of high-grade calcite, indicating a very uniform structure ; at the same time the reflections are relatively weak. Rochelle salt reflectivity data for Ag Kα are given. Percent reflection, rocking curve width and integrated reflection of barite were determined for eleven wave-lengths, and scattering factors were calculated. The variation of the scattering factor with wave-length in the neighbourhood of the barium K limit is similar to the variation previously found by Wyckoff and by Glocker and Schäfer for lighter elements, except that Wyckoff's maximum does not appear. AUTHORS.

3064. Reflection and Refraction of X-Rays by Perfect Crystals. G. W. Brindley. *Roy. Soc., Proc.* 140. *pp.* 301–313, *May* 3, 1933.—So far no really satisfactory agreement appears to have been found between the observed intensities of X-ray reflections from perfect crystals and values calculated theoretically. Such comparisons have not previously taken into consideration the atomic scattering factor, f, which is so important in the theory of X-ray reflection by imperfect or mosaic crystals. Experimental results for diamond by Ehrenberg, Ewald, and Mark are considered in relation to the theoretical results of Ewald and Darwin, and it is shown that when the scattering factor for carbon is taken into account, there is a reasonably close agreement between the experimental results and the calculated values. Ehrenberg and Mark have suggested a method for obtaining the refractive indices of perfect crystals for X-rays by measuring the angular widths of the reflected beams : it is shown that if the atomic scattering factor is taken into account, when the widths of the beams are considered, results can be obtained in satisfactory agreement with values obtained by independent methods. A. D.

3065. Structure of some Ultra-Soft X-Ray Lines. J. A. Prins. *Zeits. f. Physik.* 81. 7–8. *pp.* 507–515, *March* 30, 1933.—Previous measurements [see Abstract 5046 (1932)] are verified with finer appliances. The structure of Ag M- and W N-lines is specified. The structure of the C K-line depends on the experimental conditions. A. D.

3066. K-Series Spectrum of Tungsten. J. C. Hudson and H. G. Vogt. *Nat. Acad. Sci., Proc.* 19. *pp.* 444–448, *April*, 1933.—Results are given for photographic measurements of the tungsten K-series lines. The β- and γ-doublets are resolved and the wave-length of the δ-line determined. The wave-lengths observed are $\alpha_2 = 0\cdot21341$ Å, $\alpha_1 = 0\cdot20860$ Å, $\beta_2 = 0\cdot18477$ Å, $\beta_1 = 0\cdot18397$ Å, $\gamma_2 = 0\cdot17917$ Å, $\gamma_1 = 0\cdot17899$ Å and $\delta = 0\cdot17803$ Å. A. H.

3067. Dependence of the K-Lines of Elements from Cu to Ti on Chemical Combination. S. Yoshida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 421. *pp.* 298–310, *April*, 1933. *In English.*—The behaviour of the K-lines of elements from Cu to Ti as metals and in compounds was investigated by cold excitation with X-rays. No effects of chemical combination were observed on K$\alpha_1\alpha_2$ and K$\alpha_{3,4}$. In strongly paramagnetic compounds a distinct separation of Kβ' and Kβ_1 from each other is observed. Slight displacements of Kβ_5 are found in the case of Mn, Cr and Ti. A new line named K$^1\beta_5$ is always observed in the case of a substance which presents a white line on the long wave-length side of the edge in the absorption spectra. J. E. K.

3068. Chemical Combination and X-Ray Emission Spectrum of Sulphur. J. Valasek. *Phys. Rev.* 43. *pp.* 612–614, *April* 1, 1933.—With an improved method to eliminate the effects of chemical reactions with the target material, the wave-lengths of the sulphur Kα and β-lines were measured for the following substances : S, FeS, CoS, NiS, Cu$_2$S and ZnS. The superiority of the new technique over that usually employed is particularly evident in the spectrum of ZnS in which the Kβ-line is observed as a triplet instead of the single broad line heretofore observed. This result is independent of the target material. The Kβ-lines of CoS and NiS are observed for the first time. Two crystal modifications of ZnS, namely, zincblende and wurtzite, gave spectra which showed no appreciable differences. AUTHOR.

3069. Intensity of Spectral Lines of X-Rays from Tungsten. L. Pincherle. *Accad. Lincei, Atti,* 17. *pp.* 560–564, *April* 2, 1933.—A careful re-calculation of these intensities. The results are now in accordance with the experimental data, provided that the rays compared have the same level of arrival ; otherwise not. A. D.

3070. Relation Between Line and Continuous X-Ray Spectra. W. W. Hansen and K. B. Stoddard. *Phys. Rev.* 43. *pp.* 701–706, *May* 1, 1933.—It was discovered empirically by Webster that if an electron collides with a silver atom there is a constant ratio between the probability of ejection of a K-electron and the probability of emission of a continuous spectrum quantum of frequency between the critical K-absorption frequency and the high-frequency limit. Webster used voltages from 35 kV to 80 kV. The present work is on palladium and extends the voltage range to 180 kV; the same result holds. A step in the determination of the above ratio is to find the ratio P, for a thick target, of the amount of Kα rays resulting from ionisation by collision to that resulting from fluorescence. For palladium at normal emergence P is found to be almost constant at 2 up to 180 kV. P is needed in any comparison of the results of thin and thick target line emission experiments, since in a truly thin target ionisation is by collision only, whereas in thick targets fluorescence is also important.

AUTHORS.

3071. Future of Technical Radiology. C. N. Kemp. *Brit. J. of Radiology*, 6. *pp.* 166–172; *Disc.*, 172–174, *March*, 1933.—Possibilities of utilising X-ray examination in directions other than medical are reviewed. Where more simple methods of investigation are available, at less cost, the method is not applicable, but there are many problems in industry where the X-ray method can be applied to otherwise insoluble problems. For this purpose the apparatus should be specifically designed for the investigations in question and be as plain as possible. Possible applications are in respect to process catalysis, the avoidance of dangerous static charges in industrial processes, and the author has been directly concerned in the examination of coal and coke. In American practice welded structures submitted to high pressure are investigated and, by mass absorption methods, the percentage of tetraethyl-lead in petrol can be rapidly estimated. It is pointed out that although testing institutions have conducted such examinations in the past, examination upon the spot, *i.e.*, in the actual works, and often in secrecy, is actually required in commercial processes. Whereas in France and Germany industrial radiology is widely utilised, in this country X-ray manufacturers report that, other than medicine, the volume of business in respect to the applications of X-rays is practically nil. Education in this respect is greatly needed and the author completes his paper with various suggestions. A discussion followed.

B. J. L.

3072. New Focussing X-Ray Spectrometer. T. Johansson. *Zeits. f. Physik*, 82. 7–8. *pp.* 507–528, *May* 15, 1933.—A method is described by which accurate and selective focussing of X-rays is obtained. The method depends on the bending of a suitably polished crystal. The influence of various physical factors on the sharpness of the spectral lines is discussed, and the effects of various errors of adjustment or construction on the focussing properties of the apparatus are investigated. A vacuum spectrometer is described and photographs are given showing the results obtained with the apparatus.

J. T.

See also Abstracts 2723, 3144, 3153, 3156, 3157, 3178.

HEAT.

CALORIMETRY.

3073. Heat of Vaporisation of Hydrogen Fluoride. J. H. Simons and J. W. Bouknight. *Am. Chem. Soc., J.* 55. *pp.* 1458–1460, *April,* 1933.—The value obtained experimentally, 6025 cal./mol., although difficult to reconcile with the results of surface-tension measurements and the equilibrium of HF and H_6F_6, is in agreement with the value caculated from vapour pressure and vapour density measurements. N. M. B.

3074. Standard States for Bomb Calorimetry. E. W. Washburn. *Bureau of Standards, J. of Research,* 10. *pp.* 525–558, *April* 6, 1933.—An examination of the thermodynamics of the conditions existing in bomb calorimetry shows that the heat of combustion per unit mass of substance burned is a function of the mass of sample used, of the initial oxygen pressure, of the amount of water placed in the bomb, and of the volume of the bomb. In order to eliminate the effects of these at present unstandardised variables and to obtain a more generally useful thermal quantity which characterises the pure chemical reaction for stated conditions, it is suggested that every bomb-calorimetric determination be first corrected (where such correction is significant) so as to give the value of ΔU_R, the change of " intrinsic " energy for the pure isothermal reaction under the pressure condition of 1 normal atmosphere for both reactants and products. From this value the more generally useful quantity Q_p, the heat of the pure reaction at a constant pressure of 1 atmosphere is readily calculable. An equation for calculating the correction is given and illustrated by examples. The magnitude of the correction varies from a few hundredths of 1 % up to several tenths of 1 % according to the nature of the substance burned and the conditions prevailing in the bomb during the combustion. It is further recommended that, in approving, for the purpose of standardising a calorimeter, a particular value for the heat of combustion (in the bomb) of a standardising substance, such as benzoic acid, the value approved be accompanied by specification of the oxygen concentration and of the ratios to the bomb volume of (1) the mass of the sample, and (2) the mass of water, together with appropriate tolerances. An equation is given for correcting to any desired standard temperature the heat measured in the bomb calorimeter. AUTHOR.

See also Abstract 3116.

CONDUCTION.

3075. Energy Exchange at a Platinum-Hydrogen Interface. H. H. Rowley and K. F. Bonhoeffer. *Zeits f. phys. Chem.* 21. *Abt.B.* 1–2. *pp.* 84–92, *April,* 1933.—The Knudsen accommodation coefficient for hydrogen molecules striking the surface of a platinum wire has been measured under various conditions. It decreases with increasing temperature, and is lower for pure clean wire than for impure wire. As the ratio of para- to ortho-hydrogen is increased, the accommodation coefficient decreases. In the course of discussing the results, it is shown that the accommodation coefficient for translation is larger than that for rotation. It is the latter which accounts for the decrease with rising temperature. J. H. A.

3076. Qualitative Theorems on Heat Flow. G. Pólya. *Zeits. f. angew. Math. u. Mechanik*, 13. *pp.* 125–128, *April*, 1933.—Enunciates and proves various theorems, of which the following is typical: " If *v* is the temperature in an infinite linear homogeneous and isolated conductor, then the number of points at which *v* or any of its derivatives assumes a predetermined value, can never increase with time; the number can only diminish or remain stationary." J. H. A.

3077. Solution of Heat Conduction Problems by Method of Wave Trains. J. Robertson. *Phil. Mag.* 15. *pp.* 937–957, *May*, 1933.—Refers to the method advocated recently by Green [see Abstract 151 (1932)], and employs it to solve the following problems, amongst others: (1) Finite rod, with ends at constant temperatures or impervious to heat or losing heat by Newton's law. Initial temperature arbitrary. (2) Semi-infinite rod of two materials, the near end at constant temperature. Initial temperature arbitrary. (3) Finite rod of two materials, the ends at fixed temperatures or losing heat by Newton's law. Initial temperature arbitrary. J. H. A.

3078. Thermal Conductivity of Liquids. O. K. Bates. *Indust. and Engin. Chem.* 25. *pp.* 431–437, *April*, 1933.—A criticism is given of various methods employed in the determination of the thermal conductivity of liquids, and it is shown that values of the coefficient determined by investigators using thin films tend to be somewhat lower than the true value, and that the convection present in a liquid between horizontal plates at different temperatures suitably heated and properly guarded, is negligible. A new apparatus is described consisting of a hollow, drum-shaped container with the two circuar plane faces placed horizontally 1·92 inches apart. The upper face is electrically heated and the lower face, consisting of a test calorimeter with a guard ring, water-cooled. The temperature drops through the liquid are obtained by placing thermocouples through the liquid parallel to the surfaces. Some results are given for water and for a certain red oil. T. B.

3079. Friction, Heat Conductivity and Diffusion in Gaseous Mixtures. Part XXII. M. Trautz. *Ann. d. Physik*, 16. 7. *pp.* 751–767, *April*, 1933.—The physical meanings of collision diameters of molecules, of nuclear distances (obtained from spectroscopic data) and of lattice-diameters are discussed and also their temperature coefficients. The Maxwell diameters are calculated for Zn, Cd and Hg and the critical temperatures are deduced. The additivity of Maxwell diameters is discussed, and it appears that for molecules consisting of few atoms the diameters themselves are additive, but for those consisting of many atoms the cubes of the diameters are additive. For those cases in which the Maxwell diameters and the spectroscopic nuclear distances are most directly comparable (diatomic molecules) their ratio is proportional to the fourth root of the critical temperature. The Maxwell diameter (at T_k) is about twice as large as the lattice diameter (at $T = 0$) and the latter is about twice as large as the spectroscopic nuclear distance (at $T = 0$). [For Part XXI see Abstract 643 (1933).] G. G. S.

3080. Friction, Heat Conductivity and Diffusion in Gaseous Mixtures. Part XXIII. M. Trautz. *Ann. d. Physik*, 16. 8. *pp.* 865–886, *April*, 1933.—The diameters of 17 molecules for which values of η are available over a considerable temperature range are given on the assumption of a generalised Maxwell model (repulsions proportional to r^{-s}). The physical meanings of the values obtained and of their dependence on temperature are discussed. G. G. S.

3081. Thermal Conductivities of Rocks. H. A. Nancarrow. *Phys. Soc., Proc.* 45. *pp.* 447–461, *May* 1, 1933.—The rock specimens are turned as circular cylinders of diameter 5 cm. and height 2 cm., and are bisected by a cut made perpendicular to the base along one diameter. The top of the cylinder is heated and the temperature-gradient in the specimen is measured by means of thermocouples held in a mica holder inserted in the cut. The temperature-distribution and heat-flow in the specimen are each shown to be represented by a series containing Bessel and hyperbolic functions. Constants involved in the arguments of these functions are shown to be dependent upon the loss of heat from the hot surfaces exposed to the air in the apparatus. The determination of these surface heat-losses is described. Observations and results are given for four specimens. AUTHOR.

3082. Tables for Calculation of Temperature-Distribution in a Cylinder. H. A. Nancarrow. *Phys. Soc., Proc.* 45. *pp.* 462–468, *May* 1, 1933.—The temperature-distribution, in the case of a cylinder heated at its top surface and whose convex surface is exposed to air at the same temperature as that of the base of the cylinder, has been considered by Byerley. The present paper gives curves and a table which can be used for finding constants occurring in the expression for the temperature-distribution. AUTHOR.

3083. Measurement of Thermal Conductivity of Poor and Medium Heat-Conducting Materials. R. W. B. Stephens. *Phil. Mag.* 15. *pp.* 857–880, *May*, 1933.—A variable state method for the rapid determination of the thermal conductivity of poor or medium conductors involves the observation of the rate of rise or fall of temperature of a mass of liquid contained in a cylindrical tube of the substance under investigation. G. G. S.

CONVECTION.

3084. Transmission of Heat through Fabrics. M. C. Marsh. *Phys. Soc., Proc.* 45. *pp.* 414–423 ; *Disc.*, 423–424, *May* 1, 1933.—Previous results [see Abstract 190 (1931)] have been analysed to determine the effects of air permeability and of perforations on the thermal insulating properties of fabrics. It is subsequently shown that there is a heat-interchange between the convection currents and the fabric which is important in considering the flow of heat through such insulators. AUTHOR.

EVAPORATION.

See Abstract 3075.

MELTING AND BOILING POINTS.

3085. Solubilities, Conductivities, and Boiling-Point Elevations of Inorganic and Organic Compounds in Liquid Hydrogen Fluoride. K. Fredenhagen [with G. Cadenbach and W. Klatt]. *Zeits. f. phys. Chem.* 164. *Abt.A.* 3–4. *pp.* 176–200, *April*, 1933.—A summary is given of the available physico-chemical data relating to hydrogen fluoride, and the results of a number of experiments on its behaviour as a solvent are described. In its power to dissolve inorganic and organic compounds and to form with them solutions of good conductivity, hydrogen fluoride surpasses all other liquids, even water. With regard to solvent and ionising power, no parallelism between the acid and other solvents is evident. Especially noteworthy is the observation that chlorine, bromine and iodine form no ions in this solvent, the only anion being the fluorine ion ; no ion-precipitation reactions are shown by these solutions. Only fluorides decompose in hydrogen fluoride in the same way as in water, all other neutral salts, such as potassium nitrate, forming four ions. With solutions of organic compounds in hydrogen fluoride, additive compounds between solvent and solute are formed and undergo decomposition into a complex kation and the fluorine ion. [See following Abstract.] T. H. P.

3086. Determination of the Molecular Elevation of Boiling Point in Hydrogen Fluoride. K. Fredenhagen and G. Cadenbach. *Zeits. f. phys. Chem.* 164. *Abt.A.* 3–4. *pp.* 201–208, *April*, 1933.—Measurements made with benzoyl fluoride, benzonitrile, trichloracetic acid, and potassium fluoride by means of an apparatus described give the mean value 1·90° for the molecular boiling point elevation of hydrogen fluoride. [See preceding Abstract.] T. H. P.

3087. Azeotropic Hydrobromic Acid Solutions at Pressures of 100 to 1200 mm. W. D. and L. G. Bonner and F. J. Gurney. *Am. Chem. Soc., J.* 55. *pp.* 1406–1409, *April*, 1933.—The following data have been obtained for azeotropic water-hydrogen bromide mixtures :

Pressure in mm.	B. Pt. in ° C.	Density at 25° C.	Per cent. of HBr.
100	74·12	1·5116	49·80
200	90·35	1·5030	49·28
300	99·91	1·4961	48·83
400	107·00	1·4908	48·47
500	112·94	1·4866	48·19
600	117·82	1·4832	47·95
700	122·00	1·4802	47·74
800	125·79	1·4775	47·56
900	129·13	1·4752	47·40
1000	132·12	1·4733	47·27
1100	134·80	1·4716	47·14
1200	137·34	1·4700	47·03

T. H. P.

3088. Application of Henglein's Equation to Solutions and Mixtures. V. Kirejew. *Zeits. f. Elektrochem.* 39. *pp.* 268–269, *May*, 1933.—Henglein gave the equation $\log T_1 = a \log T_2 + b$, which connects the boiling points T_1 and T_2 of two substances at the same pressure, a and b being constants. The present paper extends this to solutions and mixtures, and gives a new and rigorous proof of the theorem. This is done separately for small and large vapour pressures. An example of the agreement between calculation and experiment is given for the case of a mixture of acetone and water. The agreement is seen to be very good. T. B.

3089. Cryoscopic Effects in Mixed Solvents and their Relation to the Solubility of Added Substances. O. Anders. *Zeits. f. phys. Chem.* 164. *Abt.A.* 3–4. *pp.* 145–175, *April*, 1933.—The experimental data include determinations of the complete solidification curve of the system acetic acid-benzene ; the freezing-point depressions of the mixtures, especially the eutectic mixtures, by sodium chromate, iodine, sulphur, chromic anhydride, and silver perchlorate ; the solubilities of these added substances in acetic acid, benzene, and their mixtures; and the compositions of all the phases of the solidification equilibrium. The compositions of the phases formed during the freezing of the benzene-acetic acid mixtures are altered by small additions of foreign substances in the direction to be expected from the solubilities. The freezing-point phenomena exhibit anomalies, caused partly by salting-out effects and probably also by polymerisation phenomena. The results indicate that sodium chromate is strongly dissociated, whereas silver perchlorate is associated. Quantitative consideration of this matter is difficult, owing to the complicated character of the systems. T. H. P.

See also Abstracts 3117, 3190.

TEMPERATURE, MEASUREMENT OF.

3090. Elimination of Parallax Error in Precision Thermometers. A. Pérard. *Comptes Rendus*, 196. *pp.* 1090–1091, *April* 10, 1933.—The position for the eye, to avoid parallax error, is determined easily if the graduations are engraved both at the front and back of the instrument, the eye then being placed so that one set appears to be exactly behind the other, in the neighbourhood of the reading. J. H. A.

3091. Errors of Fluid-Pressure Thermometers and their Correction. W. G. Bird. *Journ. Sci. Instruments*, 10. *pp.* 134–142, *May*, 1933.—An analysis is given of the errors inherent in the " readings " of fluid-pressure thermometers, especially when used in aircraft. Expressions for these errors are obtained by simple reasoning from first principles and existing methods of correction discussed. In cases where mercury cannot conveniently be used as an operating fluid on account of " freezing " troubles, a " two-fluid " arrangement in the instrument is suggested, this comprising a gas under high pressure in the bulb and a suitable " non-freezing " liquid in the capillary tube and gauge. Possible fluids are nitrogen and heptane. In many aeronautical applications of these thermometers, it is shown that the " capillary " and " altitude " errors may be made to cancel one another approximately at all heights by suitably choosing the initial pressure of the gas. AUTHOR.

3092. Thermel Technique. W. P. White. *Rev. Sci. Instruments*, 4. *pp.* 142–146, *March*, 1933.—A " thermel " (thermoelectric thermometer) has been for some time a favourite instrument for differential measurements of high precision. The use of the thermel however involves a number of possible errors, and the object of the paper is a detailed study of these errors in order to discover how they may be avoided. The chief of these are (1) insufficient depth of immersion; (2) errors in the auxiliary resistance coils; (3) error in the reference temperature; (4) inhomogeneity in the thermel; (5) imperfect insulation; (6) vagabond e.m.f.s in the lead wires, in the eliminating switch and in the thermel terminal switch; (7) error in complementary coils. With care a precision of 0·1 microvolt, corresponding to 0·0001° C. with a copper-constantan thermel of convenient dimensions, can be attained. T. B.

3093. Electrical Resistance Thermometers as Applied to Human Calorimetry. G. F. Soderstrom. *Rev. Sci. Instruments*, 4. *pp.* 285–288, *May*, 1933.—Resistance thermometers consisting of insulated nickel wire embedded in Wood's metal have given satisfactory results during the last eighteen years in measuring temperatures of the calorimeter and of various parts of the human body. Their construction is described in detail. AUTHOR.

3094. Possibility of Attaining Arbitrarily Low Temperatures. F. Simon. *Zeits. f. Physik,* 81. 11–12. *pp.* 824–831, *April* 18, 1933.—Discusses first the method suggested independently by Debye and by Giauque for the reduction of temperature by demagnetisation of a solid salt. Discusses the theory, and puts forward reasons for believing that the reduction would be very limited with such a salt as gadolinium sulphate. Sketches a new method, based on the adiabatic expansion of a condensed phase. Volume change alters the vibration frequency and therefore the characteristic temperature θ; consequently, if the change is adiabatic, the actual temperature τ must alter so as to keep θ/τ constant. Estimates that a 1 % change in volume would alter the temperature by 2 %, and that this volume change could be obtained in liquid helium with quite moderate pressures. The method has been used to cool a sample from 4·6° K. to 2·4° K. Finally, apparatus for continuous application of the method is suggested. [See also *Nature,* 131. *p.* 719, *May* 20, 1933.] J. H. A.

3095. Production of Low Temperature by Compression of Liquid Helium. W. Meissner. *Zeits. f. Physik,* 81. 11–12. *pp.* 832–839, *April* 18, 1933. *From the Reichsanstalt.*—A rejoinder to the paper by Simon [see preceding Abstract]. Points out that below 2·2° K., the coefficient of expansion of helium is negative, so that expansion would lead to heating, and not to cooling as assumed by Simon. An apparatus is then suggested, for obtaining refrigeration by the compression of liquid helium, instead of by expansion. In the last two pages, **Simon** adds a further note. He states that his experiments led him to believe that the coefficient again became positive at higher pressures, even below 2° K., and that the paper of Keesom and Clusius with its indication that this is not so, was a disappointment to him. If the properties of helium are as Meissner states, then the apparatus will have to be designed for compression and not expansion. J. H. A.

See also Abstracts 3101, 3134.

THERMOCHEMISTRY.

3096. Heat of Combustion of Cyanogen. H. v. Wartenberg and H. Schütza. *Zeits. f. phys. Chem.* 164. *Abt.A.* 5. *pp.* 386–388, *May,* 1933.—Results are given of experiments in which cyanogen was burnt in an air-oxygen stream, the quantity burnt being determined by weighing a glass tube filled with the liquefied gas. The amount of nitric oxide formed at the same time was ascertained in similar experiments, and allowance was made for its heat of combustion. At constant pressure, the heat of combustion of cyanogen is 261·3 ± 0·2 k.cal. The apparatus previously described [see Abstract 298 (1933)] was used. T. H. P.

3097. Heat of Combustion, Free Energy and Entropy of Cyanogen Gas. J. McMorris and R. M. Badger. *Am. Chem. Soc., J.* 55. *pp.* 1952–1956, *May,* 1933.—The heat of combustion of cyanogen gas is redetermined by the use of a gas calorimeter and is found to be 251,400 ± 1200 cal. The combination of this result with the heat of combustion of graphite yields for the heat of formation of cyanogen, $H_{298\cdot2} = 62,900$ cal. The entropy of cyanogen gas at 298·2° and 1 atmosphere is calculated by the use of spectral data and an estimated moment of inertia. It is found that the virtual entropy is 57·8 ± 2·0 entropy units. The combination of the above results gives for the free energy of cyanogen gas, $F_{298\cdot 2}$ = 60,000 cal. AUTHORS.

3098. Photographic Analysis of Explosion Flames. W. A. Bone. *Roy. Inst., Proc.* 27. 4. *pp.* 698–730, 1933.—Photographic analysis nowadays is capable of great accuracy and refinement, and is an indispensable part of the study of explosions. After reference to earlier researches of Mallard and le Chatelier (1883–1903) the author performed some fundamental experiments on explosions, and then describes recent developments at the Imperial College, South Kensington, with special reference to the high-speed camera of R. P. Fraser, which enables measurements of precision to be made of periodic flame movements of frequencies up to a million per second. A selection of new photographs of explosion flames was shown on the screen and their principal features pointed out. The first series dealt with initial and pre-detonation phases, the second with the phenomenon of " spin " in detonation. Several of the photographs are reproduced in the paper. T. B.

3099. Flame Temperatures of Combustible Gas-Oxygen Mixtures. H. H. Lurie and G. W. Sherman. *Indust. and Engin. Chem.* 25. *pp.* 404–409, *April*, 1933.—Measurement of the maximum flame temperatures obtainable from mixtures with oxygen of town gas of calorific values 550, 800 and 1005 B.Th.U. (138·7, 201·6 and 253·5 k.cal.) shows that they lie between 3410° K., the temperature of the oxy-acetylene flame, and 2933° K., that of the oxy-hydrogen flame. The practical application of these oxygen-gas mixtures is virtually limited to welding, as the cost of oxygen is too high for the large quantities demanded in furnace work, and cheap refractories capable of withstanding the high temperatures are not available. T. H. P.

3100. Mechanism of Flame Movement. Part III. Speed of Flame in Currents of Mixtures of Methane and Air. H. F. Coward and E. H. M. Georgeson. *Chem. Soc., J. pp.* 546–551, *May*, 1933.—The speeds of flame in various mixtures of methane and air moving as currents in a glass tube 2·45 cm. in diameter have been determined, special devices being used to ensure that flame should travel in only one direction along the tube. The results show that, in the propagation of flame from the open to the closed end of a tube, the increase in speed of uniform movement due to the current is greater than the mean speed of current, but less than the axial speed. The increase in mean forward speed during the vibratory movement was in general somewhat greater than the mean speed of current, but less than the axial speed ; for small currents, however, the increase in speed was less than the mean speed of current. In the propagation of flame from the closed to the open end of the tube, the speed of flame proved high and the results irregular ; the speed of flame was not, however, inordinately increased by the effect of the current. [For Part II see Abstract 1126 (1933).] T. H. P.

3101. Ignition Temperatures of Mixtures of Ammonia and Air. P. Laffitte and H. Picard. *Comptes Rendus*, 196. *pp.* 1486–1488, *May* 15, 1933.—By means of the same method [see Abstract 2964 (1930)] the temperatures of ignition of mixtures containing 8·9, 23·3 and 57·14% ammonia are found to be 960°, 917° (min.), and 1002° respectively, the temperature decreasing at first rapidly with increase of ammonia, then slowly to the minimum, and then increasing almost linearly to the limit of inflammation. Presence of steam has no effect, but addition of even 1 % of hydrogen causes a marked lowering. C. A. S.

3102. Thermal Decomposition of Ethyl Mercaptan and Ethyl Sulphide. W. M. Malisoff and E. M. Marks. *J. Chem. Phys.* 1. *pp.* 284–286, *April*, 1933.—The paper forms a reply to work by N. R. Trenner and H. A. Taylor [see Abstract 1549 (1933)], in which reference is made to the work of the present authors. **Trenner** and **Taylor** reply in turn to the present paper. F. J. B.

See also Abstracts 3022, 3023, 3030, 3035, 3074, 3109.

THERMODYNAMICS.

3103. Thermodynamical Fluctuations. M. v. Laue. *Zeits. f. angew. Math. u. Mechanik*, 13. *pp.* 106–112, *April*, 1933.—A short historical survey of the manner in which thermal processes were gradually recognised to have a statistical character. G. G. S.

3104. Joule-Thomson Effect and Heat Capacity at Constant Pressure for Ammonia. Kou-Cheng Su and Tzu-Ching Huang. *Chinese Chem. Soc., J.* 1. *pp.* 1–9, *April*, 1933. *In English.*—New equations for gases in terms of pressure and temperature are derived from Scatchard's modified form of the Beattie-Bridgeman equations of state and the usual thermodynamic relations. Values of the Joule-Thomson effect (μ) and of the heat capacity at constant pressure (C_p) for ammonia are calculated by the new equations for temperatures 0° to 150° C. and pressure 0 to 20 atmospheres. Good agreement is obtained with the experimental values of Osborne, Stimson, Sligh and Cragoe [Bureau of Standards, 20. 65. 1924–1926] for μ above 30° C., and for C_p above 100° C. The new equations appear to be more accurate than the " approximate " equations of Beattie, and more convenient than the " complete " equations of Bridgeman. T. B.

3105. Isothermals of Hydrogen. A. Michels and A. J. J. Gerver. *Ann. d. Physik*, 16. 7. *pp.* 745–750, *April*, 1933.—A recalculation for a wide pressure range of an empirical equation for the isothermals of hydrogen. The observations of Kohnstamm and Walstra [see Abstracts 1999 and 2000 (1914)] are combined with results obtained by the authors, and others obtained by Schalkwijk. PV is expressed as a series of ascending powers of the density *d*, up to terms involving d^8. J. P. A.

3106. Transition Points of Salt Hydrates in Various Non-Aqueous Solvents. W. W. Lucasse and H. J. Abrahams. *J. Phys. Chem.* 37. *pp.* 511–520, *April*, 1933.—The transition temperatures of some salt hydrates [$LiNO_3.3H_2O$ – $LiNO_3.\frac{1}{2}H_2O$; $CaCl_2.6H_2O$ – $CaCl_2.4H_2O\beta$; $CdBr_2.4H_2O$ – $CdBr_2.H_2O$; $Zn(NO_3)_2.6H_2O$ – $Zn(NO_3)_2.3H_2O$; $ZnBr_2.2H_2O$ – $ZnBr_2$; $CoCl_2.6H_2O$ – $CoCl_2.H_2O$]are determined from observations of the abrupt changes in the electrical resistance-temperature curves for solutions in one or more of the solvents methyl alcohol, ethyl alcohol, propyl alcohol, amyl alcohol, acetone, ethylene glycol and pyridine. Most of the curves show only a change of slope at the transition point, which can hence be calculated. In some cases, however, the slope remains nearly constant, but the magnitude of the resistance changes abruptly at the

transition point. With the exception of cobalt chloride in ethylene glycol, the transition temperature is found to be independent of the solvent.
L. A. W.

3107. Change in the Transformation Temperature of Copper Sulphate at 56° C. with the Solvent Medium. H. J. Abrahams and W. W. Lucasse. *J. Phys. Chem.* 37. *pp.* 521–524, *April,* 1933.—In aqueous solution copper sulphate is known to show a transformation point at about 56° C. The corresponding transformation points in glycerol-alcohol mixtures of different proportions are determined from the observed resistance-temperature curves [see preceding Abstract]. With decreasing alcohol content the transformation point is found to fall from 53·1° C. at 90 volume per cent alcohol to about 49·5° C. at 60 % alcohol, after which it remains practically constant down to 20 % alcohol. L. A. W.

3108. Thermodynamics of Irreversible Processes. Part III. M. Sugita. *Phys. Math. Soc. Japan, Proc.* 15. *pp.* 12–29, *Jan.,* 1933. *In German.*—This is a continuation of the author's earlier work [see Abstract 1967 (1933)]. Entropy is defined by the equation $dS = (dU - A_r)/T$ for irreversible phenomena, and A_r denotes, not the total work, but only the reversible work. This agrees with the ordinary definition for reversible phenomena, but not for irreversible phenomena, for in the heat $Q = dV - A_r - A_f$ the frictional work A_f is taken into account. This definition of entropy is called "variables of state" (*Zustandsvariablen*). The author has proved Kelvin's equation rigorously by thermodynamical methods, and the incorrectness of Boltzmann's inequality. Kennard's deduction that the entropy in a reversible "transpiration cycle" decreases, is not justified [see Abstract 2923 (1932)]. The author agrees with Bridgman's consideration of "intrinsically irreversible processes," but not with the method of proof [see Abstract 1156 (1930)]. T. B.

3109. Vapour Pressure, Free Energy and Dissociation of Iodine Cyanide. D. M. Yost and W. E. Stone. *Am. Chem. Soc., J.* 55. *pp.* 1889–1895, *May,* 1933.—Measurements of the vapour pressure of solid iodine cyanide were made and the results were found to be well represented by $\log_{10} p_{mm.} = -(13{,}940/2{\cdot}3026RT) + 10{\cdot}225$. By combining these values with those of others the standard free energy of formation of gaseous iodine cyanide was found to be $\Delta F^{\circ}_{298} = 45{,}940$ cal. It was found that gaseous iodine and cyanogen do not react to form appreciable amounts of iodine cyanide. This fact led to the conclusion that the entropy of cyanogen is, in all probability, not negative as has previously appeared to be the case. Calculations based on the third law confirmed the result found experimentally. AUTHORS.

3110. Entropy and Free Energy of Activation. V. K. La Mer. *J. Chem. Phys.* 1. *pp.* 289–296. *May,* 1933.—Evidence is presented that the energy of activation, measured by the temperature coefficient of the reaction velocity, varies with temperature. This necessitates a consideration of the activation quantities, heat capacity, free energy and entropy. The kinetic character of these quantities becomes evident, when they are developed from Tolman's statistical formulation of the Arrhenius equation. The Brönsted equation follows readily from the concept of free energy of activation. However, the development shows that the activity coefficient of the critical complex f_x(act.) is in general a kinetic quantity which becomes equivalent to the corresponding thermodynamic quantity only when all quantum levels have the same reactivity constant, or when only one level is involved. A positive heat capacity of activation furnishes evidence that the critical state is multiple in the quantum sense and that it is illegitimate to replace f_s(act.) by a thermodynamic expression. The Hinshelwood-Moelwyn-Hughes collision theory can be valid only when the entropy of activation is zero, which is improbable from the standpoint of quantum theory, the thermodynamic requirements of equilibrium processes, or the available data for activation energies in the ranges of experimental measurement. H. H. Ho.

3111. Thermodynamic Functions of Hydrocarbon Gases from Spectroscopic Data. L. S. Kassel. *Am. Chem. Soc., J.* 55. *pp.* 1351–1363, *April,* 1933.—The calculation of free energies and entropies from spectroscopic data for polyatomic molecules is developed. These factors are calculated for methane, acetylene and ethylene. The problem of representing the results of spectroscopic calculations is considered, as it is shown that this is only possible if $1/T^2$ and $1/T^3$ are included in $\Delta F/T$ terms. F. J. B.

3112. Calculation of Thermodynamic Quantities From Spectroscopic Data. A. R. Gordon and C. Barnes. *J. Chem. Phys.* 1. *pp.* 297–307, *May,* 1933.—In cases where knowledge of the molecular spectrum of a gas is sufficiently detailed to include the " stretching " and " interaction " terms in the expression for the rotational-vibrational energy states, calculation of the free energy, entropy and heat capacity for high temperatures becomes very laborious when the usual approximations are employed. In this paper, methods are developed which reduce many such calculations to a matter of interpolation in appended tables ; for cases which lie outside the range of the tables, approximations are given which materially reduce the labour of computation. The procedure is illustrated by calculations for chlorine, bromine, hydrogen chloride, carbon monoxide, oxygen and nitric oxide. AUTHORS.

3113. Free Energy of Steam and of Carbon Dioxide. A. R. Gordon. *J. Chem. Phys.* 1. *pp.* 308–312, *May,* 1933.—The free energy of steam is computed from the moments of inertia determined by Mecke and Baumann, and from the fundamental frequencies of Mecke and of Plyler, for temperatures up to 3000° K. From these numbers, the free energy of CO_2 (computed from Martin and Barker's data), the known free energies of CO and H_2, and the thermal data of Rossini, the equilibrium constant for the water-gas reaction is obtained. The calculated equilibrium constants agree with the best experimental values for the temperature range 700°–1259° K within the limits of error of the experiments. The equilibrium constant for the dissociation of steam into diatomic oxygen and hydrogen is also tabulated, but an unambiguous comparison with experiment is not possible for this reaction, since steam may also dissociate into hydroxyl and hydrogen and the data necessary for a reliable calculation of the hydroxyl dissociation are not available. A calculation for the producer-gas equilibrium predicts greater dissociation of the CO_2 into CO and graphite than is found by experiment ; this discrepancy can be accounted for if graphite is assumed to have a " zero point " entropy in excess of that given by the third law of thermodynamics. AUTHOR.

3114. Combustion Problem of Internal Ballistics. A. D. Crow and W. E. Grimshaw. *Phil. Mag.* 15. *pp.* 729–752, *April,* 1933.—A system of internal ballistics is developed, based on the assumption of forms recently put forward by the authors for the equation of state of propellant gases and for the law of the rate of burning of colloidal propellants [see Abstract 2501 (1933)]. The main analysis deals with conditions obtaining during the propellant combustion phase. Reference is made briefly to particular features of the motion during and immediately subsequent to combustion. The analysis is restricted to supposedly known conditions, no attempt being made to deal with wider applications. T. B.

3115. Thermodynamics and Relativity. R. C. Tolman. *Science,* 77. *pp.* 291–298, *March* 24, *and pp.* 313–317, *March* 31, 1933.—The author gives a mainly non-technical account of the extensions of thermodynamics to both the special and the general theories of relativity showing what additional principles are necessary for these generalisations. The chief consequences of the generalisation are also sketched, such as the possibility of a temperature gradient in a mass of gas in equilibrium under its own gravitation and the existence of an irreversible process which does not reach a final state of maximum entropy. G. C. McV.

See also Abstracts 2695, 2702, 2703, 2704, 2961, 3074, 3079, 3094, 3095, 3097.

VAPOUR PRESSURE.

3116. Physical Properties of Di-Vinyl Ether. F. T. Miles and A. W. C. Menzies. *J. Phys. Chem.* 37. *pp.* 425–430, *April,* 1933.—Measurement of the vapour pressure from −30° to +60° C., of the variation of density with temperature and the latent heat of vaporisation.

A. S. C. L.

3117. Influence of Intensive Desiccation on Physical Properties of Benzene. A. W. C. Menzies and D. A. Lacoss. *Nat. Acad. Sci., Proc.* 19. *pp.* 393–396, *April,* 1933.—The authors survey the inconsistent results obtained as to the influence of traces of water on the physical properties of substances; and set down the experimental requirements which they have met in a simplified form of isoteniscope. They studied vapour pressure chiefly, on account of its sensitiveness. No change was produced unless all dust was excluded and purified phosphorus pentoxide used; then the vapour pressure near 80° was markedly lowered or slightly raised according as drying was at room-temperature or above 80°. The maximum rise of boiling point was 2°·2, practically stationary after 20 months; even then there was no evidence of "fractionation," and no change over 0°·1 from normal freezing point. T. L. M.

3118. Vapour Pressures of Corrosive Substances. K. Arii. *Tohoku Univ., Sci. Reports,* 22. *pp.* 182–199, *March,* 1933. *In English.*—The vapour pressures of the corrosive substances, phosphorous oxychloride, titanium tetrachloride and thionylchloride, are measured by the statical method in an all-glass apparatus (Jackson's glass-spring manometer) over temperatures ranging from 20° to their boiling points, and some thermodynamical calculations are made. AUTHOR.

3119. Vapour Pressure of Vacuum Cements. R. M. Zabel. *Rev. Sci. Instruments,* 4. *pp.* 233–234, *April,* 1933.—Information concerning the vapour pressure of waxes, cements and greases is desirable in view of their use in making vacuum-tight joints. A sketch is given of the apparatus employed. The inner surface (284 cm.^{2}) of a tube A is covered with a thin layer of the substance to be tested. The tube A is connected to a liquid air trap, a pump and an ionisation gauge. All results are given in such a way that in any case where the surface area of cement exposed in a chamber and the rate of removal of gas from the chamber by a liquid air trap or pump are known the data make it possible to determine approximately the pressure of the cement which will exist in the chamber. T. B.

3120. Vapour Pressure of Cadmium Oxide. W. B. Hincke. *Am. Chem. Soc., J.* 55. *pp.* 1751–1753, *May,* 1933.—Knowledge of this vapour pressure is of importance in connection with the metallurgical treatment of cadmium-containing fumes and dusts produced as by-products in the metallurgy of lead and zinc. By means of the inert gas saturation method, measurements of the vapour pressure over the temperature range 860°–1050° have been made. The "smoothed" values vary from 0·093 mm. at 1140° K. to 2·10 mm. at 1311° K. The molal heat of sublimation over this range is calculated to be 55,600 cal., and the extrapolated normal sublimation point is 1813° K. T. H. P.

3121. Vapour Pressure of Caesium. J. H. de Boer and C. J. Dippel. *Zeits. f. phys. Chem.* 21. *Abt.B.* 4. *pp.* 273–277, *May,* 1933.—Consideration of the available data indicates that the relative vapour pressures of caesium may be best calculated by means of Langmuir and Kingdon's formula [see Abstract 1182 (1925)], but that Kröner's formula [see Abstract 1009 (1913)] yields the most reliable absolute values. T. H. P.

3122. Determination of the Vapour Pressure of Amalgams by a Dynamic Method. J. S. Pedder and S. Barratt. *Chem. Soc., J. pp.* 537–546, *May,* 1933.—Wartenberg [*Zeits. Elektrochem.* 20. *p.* 443, 1914] showed that, at 444°, conditions are favourable for the existence of a considerable proportion of the compound Na_3Hg in the vapour above the amalgam, and confirmed this possibility by analysis of the distillate obtained. The accuracy of this conclusion was questioned by Eucken and Neumann [see Abstract 575 (1923)]. An apparatus is now described for the measurement of the vapour pressures of amalgams or alloys by the dynamic gas-streaming method at temperatures between 250° and 400°. The partial pressures of mercury above cadmium amalgams at 283·5°, above zinc amalgams containing up to 56·5 mol. % of zinc at 284°, and above potassium amalgams containing up to 42·8 mol. % of potassium at 300° have been measured in this way. The results of further measurements of the partial pressures of potassium and mercury above potassium amalgams with 41·1 to 72 mol. % of potassium at 387·5° indicate that a considerable amount of a mercury-potassium compound, probably KHg, is present in the vapour of such amalgams at that temperature. T. H. P.

See also Abstract 3109.

ACOUSTICS.

3123. Sound Emission from Vibrating Membranes. M. Sasao. *Phys. Math. Soc. Japan, Proc.* 15. *pp.* 86–97, *Feb.*, 1933. *In English.*—The sound energy emission from a finite circular membrane with or without a finite flange, when vibrating in a fluid, is calculated approximately by replacing the membrane by an equivalent sphere. The addition of even a small baffle plate increases the emission. The directive properties of the membrane vary in a complicated way with the ratio of the radius of the membrane to the wave-length of the sound emitted. Experimental results agree in this respect with the theory. J. P. A.

3124. Vibration of a Circular Elastic Plate under Tension. W. G. Bickley. *Phil. Mag.* 15. *pp.* 776–797, *April*, 1933.—In view of the proposed design of a condenser microphone in which the natural frequency of vibration of the diaphragm is to be raised by the application of tension in its plane, the effects of this tension upon the normal displacement under pressure, and upon the natural frequencies of vibration, is investigated. The displacements due to several types of normal loading are worked out, and the effects of variation of the tension of the deflected form are exhibited in diagrams. The general Green function for normal load is also given. The equations upon the solution of which the calculation of the frequencies of vibration of the various normal modes depends, are given, and solved numerically in the case of six modes. Finally, numerical values of the frequencies for a sample diaphragm are calculated.

E. E. F. d'A.

3125. Absorption of Sound in the Atmosphere. Y. Rocard. *J. de Physique et le Radium*, 4. *pp.* 118–122, *March*, 1933.—The classic causes of absorption of sound in a homogeneous atmosphere are insufficient to explain the facts, since the actual absorption is at least twenty times greater than the calculated value. The large ions of the atmosphere, supposed to be formed of drops of water, appear to be capable of causing important absorption by the evaporation and condensation of water in places where the sound wave heats or cools the air. According to the author's calculations of the energy required to free a molecule of water from a large ion, and of the speed of evaporation of a large ion when suddenly heated, it results that the absorption of sound thus caused would be independent of the frequency within the audible range, and would have a definite relation to the optical transparency of the atmosphere in good weather. G. E. A.

3126. Audibility of Sounds of Varying Intensity. G. v. Békésy. *Ann. d. Physik*, 16. 7. *pp.* 844–860, *April*, 1933.—The rate of change of intensity in a room is normally different from the rate of change of the acoustic output from the sound source. The influence of various acoustic conditions upon this effect is investigated and the results are applied to questions of the audibility of speech and music in auditoria. J. E. R. C.

3127. Loudness of Noises. H. Barkhausen and U. Steudel. *Hochfrequenztechn. u. Elektroakustik*, 41. *pp.* 115–116, *April*, 1933.—It was stated in two previous papers [see Abstracts 622 (1925) and 2578

(1927)] that the loudness of a non-sine-form sound was measured by that of its loudest partial, provided that neighbouring partials differed from it in frequency by more than 20 per cent. This theory is now found not to be generally applicable, and a new theory is given in the following Abstract. G. E. A.

3128. Perception and Measurement of Sound Intensity. U. Steudel. *Hochfrequenztechn. u. Elektroakustik*, 41. *pp.* 116–128, *April*, 1933.—A cracking sound was caused by the discharge of a condenser through a telephone which had been calibrated, and gave, with a note of frequency 1000 and 2·4 mA. max. or 1·7 mA. effective, an effective sound pressure of one bar at the opening of the ear. The intensity of the sound was 70 phon (20 phon are equivalent to a difference in sound pressures in the ratio 10 : 1). The intensity of the "crack" was measured with the Barkhausen noise measurer, and noises were measured either by direct comparison with the 100 frequency standard or by comparison with a standardised noise. This has led to a formula for loudness L which is applicable to intensities greater than 50 phon, *viz.*,

$$\mathrm{L} = 20 \log\left[\frac{1}{\mathrm{P}_0}\frac{1}{\tau}\left(\int_{t_0}^{t_0+\tau}(p-p_0)dt\right)_{\max.}\right],$$

where p is the instantaneous sound pressure in bars at the entrance to the ear, p_0 the pressure at time t_0, τ the short time of duration of the sound, and P_0 a threshold value in bars. In the latter part an objective intensity measurer is described which is capable of measuring the intensity of any kind of sound. [See preceding Abstract.] G. E. A.

3129. Loudness Measurements. F. Trendelenburg. *E.u.M.* 51. *pp.* 232–236, *April* 2, 1933.—A short summary of modern methods, involving the use of electrical apparatus for the measurement of intensity of sounds, with examples of the results obtained in studies of industrial noises. W. H. GE.

3130. Sensitive Rayleigh Discs for Sound Measurements. W. Grösser. *Arch. f. Elektrot.* 27. *pp.* 329–334, *May* 2, 1933.—For sound measurements instead of the Rayleigh circular disc hitherto used, it is proposed to employ elongated rectangular discs with the object of increasing the sensitiveness. The turning moment exerted by the sound waves on such a disc is calculated. J. J. S.

See also Abstract 2894.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

3131. Measurement of Power Factor and Capacitance of a Condenser by Comparison with a Mutual Inductance. A. W. Smith. *Rev. Sci. Instruments,* 4. *pp.* 280–284, *May,* 1933.—In this method a capacitance is compared with a mutual inductance in a 1000-cycle a.c. network. The secondary of the mutual inductance is in the telephone bridge circuit and carries zero current. By using a Wagner earthing circuit there is complete silence in the telephone at the balance point. When used as a substitution method two nearly equal condensers can be compared with each other with an accuracy that is much greater than that of the resistances employed. The final balance is obtained by adjusting a small variable self-inductance in series with the primary of the mutual inductance. For a given capacitance and frequency the value of this self-inductance is directly proportional to the power factor of the condenser, and the scale of this inductance can be calibrated to read directly the value of the power factor. Vector diagrams are given to show the relations among the capacitance, power factor and the inductances, and a few typical measurements are recorded. AUTHOR.

See also Abstract 3159.

CONDUCTION AND DISCHARGE IN GASES.

3132. Controlled Dark Discharge in Free Air. A. Gemant. *Zeits. f. techn. Physik,* 14. 5. *pp.* 187–191, 1933.—An investigation was made of the conditions under which a dark discharge in air at atmospheric pressure can be controlled by an auxiliary electrode. An arrangement of about 30 parallel incandescent wires is crossed by about 8 parallel rods forming the anode. The control plate is parallel to the plane containing the wires and has an area of 12 × 30 c.m With a driving voltage of 6 to 7 kV such an arrangement behaves in air at atmospheric pressure much like an evacuated triode. From the d.c. characteristic the mutual controllance is found to be about 0·2 and the internal resistance about 1·5 megohms. These constants also hold for audio-frequency a.c., so that the arrangement can be used without modification for a.c. amplification. With suitable circuit arrangements self-excited oscillations may be obtained, the amplitude of which was about 50 volts for the arrangement used, the frequency being from 100 to 500 cycles per sec. A. W.

3133. Characteristic of Carbon Arc in Chlorine. W. Kangro and E. Jeep. *Phys. Zeits.* 34. *pp.* 300–303, *April* 1, 1933.—A study was made of the volt-ampere characteristic of a carbon arc in Cl_2 at about 700 mm. pressure. Arc lengths from 1 to 12 mm. were employed. The arc potential was found to be very low, the potential fall at the electrodes being 13·6 volts, and the fall in the arc itself 7 volts/cm. The initial portion of the characteristic is very steep, the approximately horizontal portion being reached with relatively small values of the current strength. The results are discussed in their bearing on the thermal theory of the arc. A. W.

3134. Periodic Course of the Gas Temperature in the Column of an A.C. Air Arc Light. A. v. Engel and M. Steenbeck. *Wiss. Veröff. a.d. Siemens-Konzern*, 12. 1. *pp.* 74–89, 1933.—The periodic course of the gas temperature in the axis of the positive column of a 50-period a.c. air arc light of 2 A in an inductive current circuit was determined by a stroboscopic measurement of gas density. The gas density was ascertained from the absorption capacity of the arc gas towards α-rays of a polonium preparation. The absorption capacity was obtained by an intensity measurement with a Geiger spark counter, in which the α-ray beam was led along the axis of a long straight arc stabilised by an air vortex. The gas temperature was found to oscillate in the 100-period interval between 3700° K. and 4900° K. J. J. S.

3135. Characteristics of A.C. Arcs between Metal Electrodes. J. J. Sommer and J. Bott. *Phys. Zeits.* 34. *pp.* 324–330, *April* 15, 1933.—The characteristics for a.c. arcs between electrodes of Cu, Fe, Zn, Mg and C were investigated under varied conditions. It was found that different types of characteristic were obtained according to the value of the effective current strength. With small current strengths a type of characteristic was obtained associated with the glow discharge, but with high current strengths a different type of characteristic, corresponding to the arc discharge, was obtained. In the intermediate region both types of characteristic occur, so that a double characteristic is observed. The dependence of the different types of characteristic and, in particular, the limiting current strengths for which one type changes over to the other, on the nature of the gas (O_2, H_2, N_2), the frequency of the source (50 – 8000 p.p.s.), the kind of resistance in circuit (inductive or ohmic) and on the gas pressure was investigated. A graphical representation of the limiting current strengths as dependent on the gas pressure for the different metals shows that the metals can be arranged in a series agreeing with that given by Ramberg [see Abstract 2078 (1932)] and which, on the thermal theory of the arc, correspond to the increased conductivity from C to Cu. A. W.

3136. Heavy-Current Arc in a Magnetic Field. J. Roliński. *Acta Physica Polonica*, 2. 1. *pp.* 39–44, 1933. *French Abstract*.—A homogeneous magnetic field of strength up to 320 gauss was made to act upon an arc of as much as 435 amperes and 220 volts, and its maximum length and the velocity with which the ends of the arc separated were determined by means of photographs taken on a rotating cylinder. It was found that the ends of the arc separated with a velocity proportional to the current and to the magnetic field. E. E. F. d'A.

3137. Effect of Water Vapour on Diffusion Coefficients of Ions in Nitrogen and Oxygen. J. J. Nolan and A. C. Galvin. *Roy. Soc., Proc.* 140. *pp.* 452–456, *May* 3, 1933.—Determined by the method used for air [see Abstract 3226 (1930)] the diffusion coefficients in N_2 (pure) and O_2 (containing 2 % N_2) are plotted against the pressure of water vapour present (9–14 mm. of Hg for N_2, and 0–5 for O_2). In N_2 D_- is almost constant ($0{\cdot}048 - 0{\cdot}051$); D_+ diminishes rapidly from 0·040 for the dry gas to 0·032 for 4–5 mm., and then rises slowly to 0·043 for 14 mm. There is no trace of oscillation, which, however, is very marked in O_2, and is attributed to the formation of ozone or oxides of N by the action of the α-particles producing the ionisation. C. A. S.

3138. H.F. Discharge in Gases. J. C. Wilson. *Nature,* 131. *pp.* 546–547, *April* 15, 1933.—Streamers varying in number, shape, width and velocity of rotation are observed when using a radio-frequency oscillator of the tuned-plate/tuned-grid type, for exciting the capacitative electrodeless discharge, the behaviour depending upon the closeness of tuning of the plate and grid circuits. It is suggested that the electronic displacement current and the corresponding equivalent potential difference between two points in the gas, are out of phase to an extent dependent on the divergence of the natural frequencies of the two circuits of the oscillator. The net effect on a large number of electrons is to give, in general, a rotary helical locus of maximum electronic velocity, and therefore of ionisations-by-collision. F. C. C.

3139. Anode of the Glow Discharge. A. Güntherschulze and F. Keller. *Zeits. f. Physik,* 81. 11–12. *pp.* 799–815, *April* 18, 1933.—Improvements are described in an earlier method [see Abstract 640 (1925)] for measuring the anode fall of potential and the results obtained are supplemented by probe measurements. The latter show that the rapid electrons coming from the kathode reduce the anode fall at considerable distances from the kathode, so that the true anode fall is to be found at great distances from the kathode. In consequence it is found that the method using the sudden sinking of the electrode potential on nearing the kathode gives anode falls which are several volts too low. The true anode fall found for H is 20·5 volts, for N about 30 volts and for O about 14 volts. In the case of N a narrow dark space, corresponding to the Hittorf dark space in front of the kathode, was observed between the anode glow and the anode. The anomalous anode fall for hydrogen is not much greater than the normal fall. If the anomalous current density is increased beyond a certain value, luminous beads appear in the molecular gases near the anode glow and increase in number with the current density. In Ne, however, only a single large hemispherical brush takes the place of the anode glow and the anode fall sinks to about 3 volts. The part of the anode fall lying between the Faraday dark space and the beginning of the anode glow, corresponds approximately to the excitation potential of the gases in question. In front of the anode the electrons have a Maxwellian energy distribution; their temperatures lie between 0·1 and 2·5 electron volts, according to the nature of the gas, the gas pressure, anode shape and distance of the kathode. A. W.

3140. Theory of Positive Column. M. J. Druyvesteyn. *Zeits. f. Physik,* 81. 9–10. *pp.* 571–580, *April* 7, 1933.—Various formulæ applicable to the positive column in the rare gases are reviewed and experiments to test the formulæ for the positive column of a discharge in neon are described. The gas pressure was 0·5 to 3 mm. and the diameter of the positive column 4 cm. The agreement of the experimental results with theory was in many cases good. It was found (*a*) that the electron temperature is constant across a section of the column, (*b*) that Boltzmann's statistic is valid and (*c*) that the relation between the electron concentration and the distance from the axis of the column can be represented by a Bessel function. A. W.

3141. Uniform Positive Column. F. L. Jones. *Phil. Mag.* 15. *pp.* 958–968, *May,* 1933.—The general equation for the uniform positive column is derived: $(Z/p)^{-\frac{1}{2}}.f(Z/p) = B/R^2p^2$ where Z is the electric force, p the gas pressure, R the radius of the tube and B is a constant.

This agrees with an expression given previously by Seeliger [see Abstract 3397 (1932)]. The function f is determined for a Maxwellian distribution of the energies of the electrons and the results are in fair agreement with the experimental values for helium. For neon the agreement is not so good and the whole treatment fails at low pressures, for which region, however, a satisfactory formula has already been derived by Druyvesteyn [see Abstract 702 (1933)]. F. C. C.

3142. Kathodic Disintegration of Platinum by Mercury Ions. J. E. Henderson and Edith Gideon. *Phys. Rev.* 43. *pp.* 601–604, *April* 15, 1933.—The kathodic disintegration of platinum by mercury ions has been measured for ion velocities up to 2000 volts. The mercury ions were isolated into a beam and allowed to strike a platinum surface under such conditions that the secondary electron emission could be measured as well as the disintegration produced. The disintegration per positive ion was found to increase linearly with the energy of the ion up to 2000 volts. Approximately two atoms of platinum are ejected per incident ion of 1000 volts energy. Curves are shown which give the characteristics of the secondary electron emission as a function of the energy of the ion. AUTHORS.

3143. Influence of a Magnetic Field on Anode Spot. T. Takamine, T. Suga and A. Yanagihara. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 425. *pp.* 26–33, *May*, 1933. *In English.*—Continuing previous experiments [see Abstract 1988 (1933)] it was found that when the discharge tube was adjusted so that the tip of the pointed anode was placed at the strongest part (4600 gauss over a gap of 58 mm.) of a longitudinal magnetic field, the brightness of the anode spot was increased considerably. The pressure in the tube ranged from a few mm. up to a few cm. of mercury, the current from a few to a few hundred mA, and the distance between the electrodes from 1 to 50 cm. Investigation by means of a falling plate camera showed that the anode spot became brighter, not only by its increase in size, but also by the more frequent emission of brighter flashes under the influence of the field. F. C. C.

3144. Excitation Potentials of Beryllium. H. W. B. Skinner. *Roy. Soc., Proc.* 140. *pp.* 277–301, *May* 3, 1933.—When a metal is bombarded by electrons of a defined voltage, the variation of the intensity of the radiation emitted with the value of this voltage is called the excitation curve of the metal. New measurements of the curve for beryllium are described, and the characteristic break-potentials are tabulated. Both tungsten and dull-emitter filaments have been used, and it is shown that the breaks are displaced corresponding to the change of filament. When a correction for the work-function of the filament is applied, the break-potentials obtained are consistent. Radiation begins when the energy of the exciting electrons exceeds 8·5 volts. The minimum K-excitation potential is found to be 92 volts. At this point the curve starts a series of violent fluctuations which persist up to about 125 volts; thereafter the fluctuations are comparatively mild. With a slightly oxidised surface, the set of fluctuations starting at 92 volts does not occur: a break at about 116 volts is found. A discussion of the process of excitation of K-radiation in light metals is attempted. An approximate model for the excited state, based on the state for the corresponding atomic system, is suggested. It seems possible to account for the magnitudes of the minimum K-excitation potentials of lithium and beryllium metals; and calculation indicates that all the stronger breaks in the observed curves may be correlated with the higher energy-states of the free atoms or ions. Different results may also be expected for the pure metals and for the oxides. [For lithium, see Abstract 2453 (1932).] A. D.

3145. Excitation Potentials of the Argon Atom. R. G. Loyarte. *Phys. Zeits.* 34. *pp.* 416–420, *May* 15, 1933.—A large number of critical potentials of the argon atom are determined by the photoelectric method. Most of these potentials correspond closely with optically determined states of the argon atom. Some critical potentials, especially in the region between $1s_2$ and $2p_{10}$, correspond to hitherto unknown optical states. With the help of known levels and unclassified optical lines a term, X=29763·9, is discovered which gives rise to a number of the unknown critical potentials of about 12 volts. Four lines of medium intensity are classified with a considerable degree of certainty as transitions between known terms and the term X. J. E. K.

3146. Ionising Potentials for Atoms and Ions of Rare Gas Type. J. A. Wasastjerna. *Soc. Scien. Fennica,* 6. 20. *pp.* 1–6, 1932–1933. *In English.*—Characteristic energy values E are calculated from the atomic or ionic refractions for atoms or ions of rare gas type. Ionising potentials for a number of such atoms or ions are tabulated and also for the rare gas ions. The agreement between theoretical values and those obtained spectroscopically is satisfactory. G. G. S.

3147. Ionisation of Argon, Neon and Helium by A, Ne and He Atoms. C. J. Brasefield. *Phys. Rev.* 43. *pp.* 785–787, *May* 15, 1933.—The ionisation of argon, neon and helium under impact of A, Ne and He atoms was investigated by a method which eliminated errors due to secondary electrons. When argon, neon and helium were bombarded with their own atoms, ionisation was found to set in at approximately 100 equivalent volts in each case. When any one of these three rare gases was bombarded with atoms of either of the other two, no ionisation could be detected. If ionisation had set in at 150 volts or less it should have been apparent. AUTHOR.

3148. Mass-Spectrograph of the Parabola Type with Increased Sharpness of Line. H. Lukanow and W. Schütze. *Zeits. f. Physik,* 82. 9–10. *pp.* 610–619, *May* 23, 1933.—A new method of constructing a Thomson mass-spectrograph is described, in which the canal rays are excited in a metal discharge tube and a small cylindrical tube and plane diaphragm are used for defining the limits of the beam. A resolving power of 1/600 is obtained. In the case of the inert gases He, Ne and A, a complex ion is discovered which appears to be a hydride of the corresponding inert gas. A method of proving the existence of the hydrogen isotope H^2 by means of the mass-spectrograph is described. J. E. K.

3149. Trajectory of Electrons in a Longitudinal Magnetic Field. B. Kwal. *Comptes Rendus,* 196. *pp.* 758–760, *March* 13, 1933.—When a beam of kathode rays traverses a longitudinal magnetic field, it presents in general periodic concentrations and dilatations. The author develops the theory of these, and shows that the most general motion is that of a helix threaded on a line parallel to the field. But there may also be straight and thread-like beams which are analogous to similar structures in hydrodynamics. E. E. F. d'A.

3150. Optics of Braun L.T. Tube. E. Brüche. *Arch. f. Elektrot.* 27. *pp.* 266–274, *April* 10, 1933.—The electrode system of a low-voltage oscillograph tube in which gas concentration of the electron beam is used, is similar to that of an electron microscope. The enlarged image of the kathode given by such a system on the fluorescent screen is reduced practically to a luminous point by the optical concentration effect of the gas present in the tube. Experiments with tubes of the A.E.G. oscillograph type are described confirming this view and leading to certain conclusions regarding the constructional details of the various parts of the electrode system, which give the best results in practice. [See also Abstracts 5201 (1932), 339 (1933).] A. W.

3151. Geometrical Electron-Optics of the Axial-Symmetrical Electromagnetic Field. W. Glaser. *Zeits. f. Physik,* 81. 9–10. *pp.* 647–686, *April* 7, 1932.—With the help of a formula for the refractive index of the general electromagnetic field previously developed [see Abstract 2001 (1933)], the differential equations for electron rays in a field with axial symmetry are derived, and those for rays near the axis are solved. Formulæ are given for an electric and magnetic field which correspond to given electron-orbits. The exact formula for refracting power and focal length of an " electron lens," consisting of electric and magnetic fields and space charge, is derived for the case of a field of finite extent, and for the infinitely thin lens, conditions are deduced which must be satisfied by the combination of electric and magnetic fields in order that the system may be free from aberration, etc. Finally, it is shown that the path of an electron in an axial-symmetrical field may be considered as an optical ray in an isotropic medium whose refractive index is given. It follows that the possible errors of the axial-symmetrical electromagnetic instrument are in general qualitatively the same as those of an optical instrument. C. B. A.

3152. Mobility of Electrically-Charged Carriers in Strong Electric and Magnetic Fields Simultaneously Applied. G. A. Kugler, F. Ollendorff and A. Roggendorf. *Zeits. f. Physik,* 81. 11–12. *pp.* 733–744, *April* 18, 1933.—A mathematical discussion is given of the effect of simultaneously applied strong electric and magnetic fields on the paths of electrically-charged carriers, such as may be found in a mercury-vapour arc. The discussion is limited to the case where the fields of force have such a preponderating effect on the motion of the carriers that thermal movements of the gas molecules can be regarded as negligible in comparison. [See also Abstract 1990 (1933.] A. W.

3153. Temporary Activation of Geiger-Müller Counters after Treatment with X-Rays. R. Brunetti and Z. Ollano. *N. Cimento,* 10. *pp.* 92–99, *Feb.,* 1933.—Geiger-Müller counters were subjected to prolonged irradiation with X-rays. They showed after the irradiation a strong increase in the number of their internal discharges, decreasing with time and different with equality of irradiation for different metals. Various experiments carried out under different conditions showed that the activation obtained depends on a temporary alteration of long duration of the internal surface of the walls of the counter, produced by the radiation that it has received. The nature of the process on which the activation depends is being studied. J. J. S.

3154. Spread of the Discharge in Geiger-Müller Counters. E. Greiner. *Zeits. f. Physik,* 81. 7–8. *pp.* 543–555, *March* 30, 1933.—It is shown by experiment that in a Geiger-Müller tube the discharge resulting from the entry of an α particle is spread throughout the whole volume through the action of an ultra-violet radiation called into existence by the discharge itself. Absorption measurements with different filling gases showed that this radiation was characteristic of the gas. Incidentally, it is noticed that a Geiger-Müller tube thus provides a very sensitive method for the measurement of the absorption coefficient of very weak ultra-violet radiations. J. E.

3155. Influence of the Walls on the Discharge of the Tube Counter. J. N. Hummel. *Phys. Zeits.* 34. *pp.* 331–335, *April* 15, 1933.—The effect of the tube length on the starting potential of the tube counter is investigated and curves are obtained showing that the required potential decreases as the length is increased, and reaches a steady value for tubes greater than 7 cm. in length. The starting and stopping potentials of a discharge are shown to vary between two limits. In addition to the ordinary electrostatic field between kathode and anode, fields are present due to free charges and double layers on the kathode surface and on the surface of the insulators at the ends of the counter. Irregular behaviour and variations in the working conditions with time, are attributed to variations in this additional field. F. C. C.

3156. Application of the Electrometer Triode to the Measurement of Ionisation Current. J. A. C. Teegan and A. M. Hayes. *Journ. Sci. Instruments,* 10. *pp.* 110–114, *April,* 1933.—A simple circuit is described in which use is made of the high grid insulation of the electrometer triode, for the measurement of ionisation currents of the order of 10^{-15} ampere. Various applications are indicated, and a convenient variable resistance of the order of 10^{12} ohms is described. The method is found very suitable for the comparison of the γ-ray intensities from radium samples. F. C. C.

3157. Electrometer Triode in the X-Ray Ionisation Spectrometer. W. A. Wooster and B. W. Robinson. *Nature,* 131. *pp.* 545–546. *April* 15, 1933.—The authors separately point out that the electrometer triode had been applied to X-ray ionisation spectrometers for several years prior to the recent suggestion by J. A. C. Teegan [see preceding Abstract]. The best working conditions are discussed. F. C. C.

See also Abstracts 2696, 2993.

CONDUCTION IN SOLIDS AND LIQUIDS.

3158. Theory of Metals. R. Peierls. *Zeits. f. Physik,* 81. 9–10. *pp.* 697–699, *April* 7, 1933.—Although admitting the correctness of Wilson's results [see Abstract 1166 (1933)], the author shows that Wilson's refutation of several of his (Peierl's) conclusions is invalid owing to a misunderstanding arising from the use of different variables by the two investigators. W. S. S.

3159. Valve-Voltmeter for Measurements of Hydrogen-Ion Concentration. A. S. McFarlane. *Journ. Sci. Instruments,* 10. *pp.* 142–147, *May,* 1933.—The paper describes a direct-reading pH-meter based on a modified valve-bridge compensation scheme which offers enhanced zero stability. The instrument is self-standardising and embodies a scale-extending device which enables pH readings, accurate to 0·01 pH, to be made with a portable scale-pattern galvanometer. AUTHOR.

3160. Variation of the After-Effect of Quartz with Temperature. S. Shimizu. *Tohoku Univ., Sci. Reports,* 22. *pp.* 61–87, *March,* 1933. *In English.*—The effect of the temperature, on the after-effect of the electrical conductivity of quartz plate was studied under various temperatures, and the following conclusions were obtained. The recovery time and the ratio of the electrical resistivity of the neutral state to that of the apparent one, $(R_n/R)_{t=0}$ decrease inversely proportionally with the temperature, and the former at a temperature of 300° C. becomes one-tenth of that at 10° C. The variation of the recovery time with the previously applied potential of a quartz plate cut perpendicular to its optical axis shows an anomalous change at the limit potential at room-temperature, and this anomaly disappears slowly as the temperature rises, and becomes a continuous change in the range of temperature above 300° C., and the effect of the charging time on the after-effect varies also with the temperature. [See Abstract 2958 (1932).] AUTHOR.

3161. Contacts of Two Different Conductors. R. Holm and R. Störmer. *Wiss. Veröff. a. d. Siemens-Konzern,* 12. 1. *pp.* 61–73, 1933.—The one body and one metal contact problem is further dealt with. Formulæ are deduced by which the potential and the temperature at any desired spot on the conductor between the end surfaces can be calculated on the assumption of the validity of the Wiedemann-Franz law. Similar formulæ are deduced for contacts between two different conductors. Contacts between graphite or carbon and metal are dealt with. It is found that under certain circumstances very high temperatures can occur in the carbon without the corresponding touching surface appearing to be highly heated. The characteristic of two metal contacts is considered.

J. J. S.

3162. Copper-Cuprous-Oxide Rectifier and Photoelectric Cell. L. O. Grondahl. *Rev. Modern Physics,* 5. *pp.* 141–168, *April,* 1933.—This is a critical review dealing mainly with the history, manufacture, characteristics and theory of the copper-cuprous-oxide rectifier, the account of the copper-cuprous-oxide photoelectric cell being confined to a relatively short concluding section. Some previously unpublished matter is included: notably a number of microphotographs showing the structure of the metal and oxide layers and the reticulum upon their surfaces after separation; and, in connection with manufacture, resistance-voltage characteristic curves for rectifiers cooled slowly in air and quenched in water. The various theories of the action of the rectifier are discussed critically. The appended Bibliography contains references to 141 publications. L. A. W.

3163. Supraconductivity and the Hall Effect. I. Kikoin and B. Lasarew. *Phys. Zeits. d. Sowjetunion,* 3. 4. *pp.* 351–365, 1933. *In German.*—Points out that for most supraconducting metals $R\sigma$ at room-temperature is of the order of 10, whilst for most metals which do not show supraconductivity, $R\sigma$ is greater than 100. Here R is the coefficient of the Hall effect and σ is the electrical conductivity. The anomalous metals in both series are discussed, and largely explained. An experimental investigation of some alloys and compounds shows that the supraconductors among them exhibit the same distinction as the pure metals. J. H. A.

3164. Theory of Supraconductivity. J. Dorfman. *Phys. Zeits. d. Sowjetunion*, 3. 4. *pp.* 366–380, 1933. *In German.*—Discusses the theory of the supraconducting state from the point of view that when a metal is in this condition, the electrons are in a different energy state from the normal. The influence of a magnetic field is explained, and the theory found to predict correctly the formula connecting field-strength and the temperature at which supraconductivity sets in. The effect of h.f. currents is also successfully explained, and the anomaly of the specific heat is discussed. On this theory, about 2 % of the valency electrons present take part in supraconductivity. J. H. A.

3165. Interpretation of Supraconductivity. L. Brillouin. *Comptes Rendus*, 196. *pp.* 1088–1090, *April* 10, 1933.—Points out that an energy curve of a certain type for the electrons in a crystal lattice would explain the existence of supraconductivity, and its destruction by a magnetic field, as also the fact that the thermal conductivity does not show an analogous phenomenon. J. H. A.

3166. Electrical Conduction and Diffusion in Solid Silver Sulphide, Selenide and Telluride, and the Mechanism of their Formation from the Elements. C. Tubandt, H. Reinhold and Anne L. Neumann. *Zeits. f. Elektrochem.* 39. *pp.* 227–244, *April*, 1933.—The conductivity of α-Ag_2Se was found to be abnormally high, and similar in this respect to pure α-Ag_2S. Treatment with selenium lowered the conductivity of the selenide in a similar manner to the lowering of the conductivity of the sulphide by treatment with sulphur. The velocity of diffusion of α-Ag_2Se and of α-Ag_2Te was found to be of the same order as that of other good conducting solid electrolytes. The diffusion constants were found to be expressed by the equations :

$$\alpha\text{-Ag}_2\text{Se, D} = 13\cdot 37e^{-\frac{1470}{T}} \quad \alpha\text{-Ag}_2\text{Te, D} = 3\cdot 33e^{-\frac{1330}{T}}.$$

Transport measurements showed that α silver sulphide, selenide and telluride, in the pure state, were electrolytic conductors. In the presence of excess of the negative element, metallic conduction was obtained in addition to the electrolytic. The conductivity of the β-modification of both these compounds was practically pure metallic conduction. F. J. B.

3167. Resistance Measurements of Palladium Wire Containing Hydrogen. C. A. Knorr and E. Schwartz. *Zeits. f. Elektrochem.* 39. *pp.* 281–283, *May*, 1933.—In the estimation of the resistance of palladium wire containing hydrogen, immersed in an electrolyte, it was found that a correction had to be applied on account of the conducting power of the solution. Polarisation phenomena were responsible for changes in the conducting power of the electrolytes, which had the increase of the apparent resistance of the wire with time as a consequence. The conducting power of the solution was greater, the greater the activity of the wire, and the greater the hydrogen content of the wire. F. J. B.

3168. System Water-Phenol. Part III. Electrical Conductivities. O. R. Howell and C. Handford. *Faraday Soc., Trans.* 29. *pp.* 640–653, *May*, 1933.—The conductivities of a series of solutions of water and phenol of different concentrations, suitably spaced over the whole range of miscibility, have been measured at 20°, 30°, 40°, 50°, 60° and 70° C. A very sensitive arrangement embodying the "Wagner earth" and employing a loud-speaker for the determination of electrical conductivities is described. A still for the preparation of conductivity water and a cell suitable for determining the conductivity of badly-conducting solutions at a series of temperatures are described. The form of the conductivity-concentration curves is discussed. The conductivity-temperature curve for each concentration is smooth and represented by the equation: $k_t^\circ = k_{20}^\circ + \alpha(t - 20) + \beta(t - 20)^2$. The curves of the constants α and β against the concentration (like those of the density-temperature and viscosity-temperature relations) exhibit inflexion at a concentration corresponding to equi-molecular proportions of water and phenol. The association of water and phenol in equi-molecular proportions is explained by the dual dissociation of phenol: $C_6H_5OH^{\cdot}{}_2 + OH' \rightleftharpoons C_6H_5OH + H_2O \rightleftharpoons C_6H_5O' + OH^{\cdot}{}_3$ and formation of the compound $(C_6H_5OH^{\cdot}{}_2)\,(OH')$. [For Part II see Abstract 906 (1933).] AUTHORS.

3169. Measurement of the Conductance of Electrolytes. Part V. Redetermination of the Conductance of Standard Potassium Chloride Solutions in Absolute Units. G. Jones and B. C. Bradshaw. *Am. Chem. Soc., J.* 55. *pp.* 1780–1800, *May,* 1933.—Most of the data on conductance in the literature are based on the values ascribed to standard reference solutions, especially *N* and 0·1*N* potassium chloride solutions, by Kohlrausch (*Wied. Ann,* 64. *pp.* 417–455, 1898). In view of the great discrepancies between these values and those obtained later by Parker and Parker [see Abstract 1581 (1924)], a redetermination of the standards of reference has been made. A new bridge has been designed to avoid certain systematic errors and a method for determining the absolute specific conductance of solutions has been developed. The cell constants are determined by resistance measurements when the cells are filled with mercury, instead of by measuring the linear dimensions of the cells. The specific conductances of three standard potassium chloride solutions containing respectively 71·1352, 7·41913, and 0·745263 gm. of KCl per 1000 gm. of solution *in vacuo* have been thus determined at 0°, 18° and 25°. It is recommended that the new values should be used for the determination of cell constants. T. H. P.

3170. Conductivity of α-Silver Sulphide. C. Wagner. *Zeits. f. phys. Chem.* 21. *Abt.B.* 1–2. *pp.* 42–47, *April,* 1933.—It is known that for α-silver sulphide there is a large discrepancy between the experimental and calculated values of the diffusion constants of ions in the salt. Starting from this observation it is shown that a simple explanation for earlier observations is possible if it is assumed that the major part of the electrical conductivity can be ascribed to electron conduction. J. E. R. C.

3171. Conductivity of α-Silver Sulphide. Part II. W. Jost and H. Rüter. *Zeits. f. phys. Chem.* 21. *Abt.B.* 1–2. *pp.* 48–52, *April,* 1933.—The velocity of diffusion of copper ions in α-silver sulphide in very low concentrations has been measured and the result agrees with other measurements made at higher concentrations. Measurements of the mobility of copper and silver ions disclose several anomalies which are also observed with pure silver sulphide. The Faraday law appears not to hold at high current densities. The anomalies can be explained on the basis of Wagner's assumption [see preceding Abstract] as to the mechanism of electrical conductivity in α-silver sulphide. [See also Abstract 3056 (1932).] J. E. R. C.

3172. Conducting Properties of Caoutchouc Strongly Charged with Lamp Black. J. Granier. *Comptes Rendus*, 196. *pp.* 1009–1011, *April* 3, 1933.—By treatment with mineral or organic substances such as lamp black the electrical properties of the caoutchoucs of commerce are greatly modified. Specimens incorporated with lamp black from 0·5 to 50 % were examined. One of these with a.c. showed very high inductive power (31 at a frequency of 600, and 22 at a frequency of 15,000). With d. c. it was freely conducting, and this conductivity appeared to be of purely electronic nature. The conductivity is considerably increased by extension or by compression. Some applications of this conductivity are described. J. J. S.

3173. Determination of Isoelectric Point. L. V. Andrews and D. J. Brown. *J. Phys. Chem.* 37. *pp.* 417–424, *April*, 1933.—The isoelectric point of lead oxide has been found; it forms a true solution and has the ionisation constant of a moderately weak base. A. S. C. L.

3174. Adoption of the Absolute System of Electrical Units of Measurement. L. Lombardi. *Accad. Lincei, Atti*, 17. *pp.* 342–345, *March* 5, 1933.—A summary of the arrangements made in setting up the international system of electrical units of measurement, with particulars of the steps which are in progress for the definite substitution of the absolute system of units for the international system. J. J. S.

See also Abstracts 2673, 2687, 2721, 3085, 3106, 3107, 3182, 3192, 3255.

DIELECTRICS AND CAPACITANCE.

3175. Calculation of Electric Moments. G. Allard. *Comptes Rendus*, 196. *pp.* 1095–1097, *April* 10, 1933.—Justifies the method of calculating electric moments of molecules by vectorial addition of the partial moments due to the constituents of the molecule. J. H. A.

3176. Polarisabilities of Ions from Spectra. J. E. and Maria G. Mayer. *Phys. Rev.* 43. *pp.* 605–611, *April* 15, 1933.—The polarisabilities of the gaseous alkali ions, and several other ions of rare gas structure, have been calculated by the Born-Heisenberg method from the corresponding spectra. Correction has been made for the effect due to "penetration" and for higher order distortion of the ion. The quantum mechanical derivation of the method has been given. The values of the polarisation of the alkali ions so obtained are found to be somewhat lower than those previously assumed. The polarisabilities of the gaseous negative ions must be correspondingly higher. The decrease in polarisability of the negative ion and increase of the positive ion on inclusion in a crystal is in agreement with known frequency shifts. AUTHORS.

3177. Ionic Polarisation in Crystals. J. Errera and H. Brasseur. *Phys. Zeits.* 34. *pp.* 368–373, *May* 1, 1933.—In anhydrous crystals the difference between the dielectric constant, ϵ, and the square of the refractive index for infinitely long waves, n_0^2, is attributable to ionic polarisation arising from ionic oscillations. For substances of similar structure, the proportion of the total polarisation attributable to the ions is greater,

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the smaller the ionic radius, the inter-ionic distance and the electronic deformability. In hydrated salts, the presence of water of crystallisation causes dispersion in the direction of an axis. [See Abstract 4477 (1932).] J. S. G. T.

3178. Investigation of the Dielectric Properties of Rochelle Salt by Means of X-Rays. H. Staub. *Phys. Zeits.* 34. *pp.* 292–296, *April* 1, 1933.—It is shown that the intensities in the X-ray diffraction pattern from a crystal of Rochelle salt can be affected by the application of an electric field to the crystal. The dependence of the variations in intensity on temperature and field-strength is investigated, and it is shown that the abnormally high dielectric constants of Rochelle salt are connected with the abnormally high ionic displacement in the space-lattice. G. G. S.

3179. Determination of the Dielectric Constants of Semi-Conductors and of Rochelle Salt. G. Oplatka. *Phys. Zeits.* 34. *pp.* 296–300, *April* 1, 1933.—A modification of the usual method of discharging a condenser through a ballistic galvanometer is used, the modification consisting chiefly of a special switching arrangement whereby the time required to switch over from charge to discharge is reduced to 10^{-7} sec. The dielectric properties of Rochelle salt are investigated, in particular the dependence of the dielectric constants on the duration of the charge and on the applied field. G. G. S.

3180. Dipole Moments of Mercaptans and Sulphides. W. S. Walls and C. P. Smyth. *J. Chem. Phys.* 1. *pp.* 337–340, *May*, 1933.—The dipole moments of thianthrene, two thioethers and two mercaptans are measured and compared with values in the literature. The differences in moment of corresponding oxygen and sulphur compounds are attributed to inherent differences in the H–O, C–O, H–S and C–S moments and to the greater polarisability of sulphur as compared to oxygen. In contrast to the oxygen ethers, the thioethers show as much intermolecular action as the mercaptans. AUTHORS.

3181. Dielectric Constants of Aqueous Solutions of Amino-Acids and Polypeptides. M. Frankenthal. *Zeits. f. phys. Chem.* 21. *Abt.B.* 4. *pp.* 310–316, *May*, 1933.—Previous results in this field [see Abstract 1175 (1933)] are now corrected and compared with Devoto's data; good agreement is found. H. H. Ho.

3182. Current and Field Behaviour in Insulating Materials with Thin Mobile Charged Layers. W. O. Schumann. *Arch. f. Elektrot.* 27. *pp.* 241–253, *April* 10, 1933.—The effect of space charges is of primary importance in determining the characteristics of the electric conductivity in dielectrics and in a previous paper [Abstract 2562 (1933)] the effect of a single thin charged layer was dealt with. In the present paper a discussion is given of the effect of more than one such layer. These layers may, for example, be produced at the electrodes and be set in motion by the applied potential. With two electrodes the possibility of two such layers must be reckoned with and if the layers at the electrodes are made up of carriers having different charges and mobilities, the motion of these may give rise to a whole series of such layers. According to the charge, number and position of these layers various time and frequency effects are found in the current and field in the material in question. A. W.

3183. Lower Curie Point of Rochelle Salt. B. and I. Kurtschatow. *Phys. Zeits. d. Sowjetunion,* 3. 3. *pp.* 321–334, 1933.—The value of the dielectric constant of Rochelle salt and other isomorphic crystals was measured at different temperatures in weak fields and with alternating currents, and for the Rochelle salt maxima were found at $-15°$ and $+22\cdot5°$ C. It has been shown that in weak fields this salt has a maximum dielectric constant at the Curie point. The authors designate the lower of the given temperatures the lower Curie point. They suggest that these maxima occur through the disappearance of spontaneous orientation, that the maximum at the higher temperature is caused by the heat movement of the dipoles, and that at the lower temperature by reciprocal action of the dipoles with the lattice. [See Abstract 1338 (1931).] G. E. A.

3184. Frequency Variation of the Dielectric Constant of Dilute Non-Aqueous Solutions. J. L. Oncley and J. W. Williams. *Phys. Rev.* 43. *pp.* 341–354, *March* 1, 1933.—For systems containing polar molecules it has been found that there is a wave-length region in which the dielectric constant decreases with increasing frequency, this wave-length region determining the time of relaxation for polar molecules for rotation of a particle in a viscous medium. Viscous solutions of polar substances in non-polar, non-aqueous media have been investigated with an apparatus, which is described. The dielectric constants have been measured at frequencies as high as 2×10^7 cycles per sec., and results for rosin solutions in mineral oils, and mixtures of "floricin," paraffin oil and vaseline are given. The effect of viscosity is very slight. Objections are raised to the use of the ordinary coefficient of viscosity of the medium to measure the frictional resistance to the rotation of a molecule when the discontinuities are large compared with the size of the rotating particle. Differentiation between systems in which the suspended particles are monodisperse or polydisperse is possible. W. R. A.

3185. New Method for the Determination of Electrostriction in Gases. J. Jaumann. *Phys. Zeits.* 34. *p.* 282, *April* 1, 1933.—A method is described which avoids the errors of previous determinations of electrostriction in gases, and from data obtained with He, H_2, N_2, O_2, CO_2 and SO_2 at room-temperature (and in contradiction to Kliefoth's measurements) the effect is found to be absolutely proportional to the square of the field strength. The pressure dependence of the effect, however, is only proportional to the density in the cases of He and H_2, all the other gases at high pressures exhibiting a more rapid increase equivalent to an additional quadratic term. H. H. Ho.

See also Abstracts 3131, 3267.

ELECTROCHEMISTRY.

3186. Standard Battery. R. B. Elliott and G. A. Hulett. *J. Phys. Chem.* 37. *pp.* 489–494, *April,* 1933.—The Weston battery $CdAm/CdSO_4$ (saturated at 4°)$/Hg_2SO_4/Hg$ gives a constant current and is unaffected by temperature changes, but is liable to anode polarisation. Details are given for the most suitable anode to kathode areas, and the preparation of materials for the construction of a battery to give any desired current and to remain unaffected over long periods. N. M. B.

3187. Short-Circuit Electrolysis. E. Manegold and R. Hofmann. *Zeits. f. Elektrochem.* 39. *pp.* 244–251, *April*, 1933.—Solutions of sodium sulphate, nitrate and chloride were electrolysed between two electrodes which were separated by 1 mm. The electrodes consisted of a copper and a carbon roller, which were rotated at a speed sufficient to maintain a layer of the electrolyte between them. The products of the electrolysis remained in the surface layer on the rollers, and were removed by a scraper and collected. The current efficiency of the process was approximately 95 %, and the energy yield was about 30 % for N Na_2SO_4, 40 % for 1·7N $NaNO_3$, and 30 % for 2N NaCl. F. J. B.

3188. Electrochemical Phenomena in the Catalytic Decomposition of Hydrogen Peroxide by Platinum. R. Wolff. *Comptes Rendus*, 196. *pp.* 1113–1116, *April* 10, 1933.—The equation $E = 0{\cdot}058p\text{H} + 0{\cdot}029r\text{H}$, where $e^{-r\text{H}}$ is the partial pressure of hydrogen at the electrode, gives the p.d. at 18° at a platinum electrode immersed in normal hydrogen peroxide for pH 1·25 to 11·34 ; rH is approximately constant, 27–28·7, average 27·8. This potential is not one of equilibrium, but is connected with the catalytic decomposition of the peroxide. The reaction is best explained as activation of the peroxide in two ways : $H_2O_2 = 2H^+ + O_2 + 2\ominus$, and $H_2O_2 = 2(OH)^- + 2\oplus$, the H^+ and $(OH)^-$ then form H_2O on the platinum, the potential being that due to the equilibrium between H_2O and its constituents. C. A. S.

3189. Hydrogen Effect. H. v. Halban and G. Kortüm. *Zeits. f. Elektrochem.* 39. *pp.* 288–289, *May*, 1933.—In connection with the investigation of the behaviour of organic acids in solutions of strong electrolytes [see Abstract 2522 (1930)] the authors have re-examined the " hydrogen effect " affirmed by L. Wolf in order to find if it was an actual source of error in potential measurements. They find the effect considerably smaller than the value given by Wolf and in any case if such an effect occurs in the experiments on organic acids it lies under the fixed limits of error. J. J. S.

3190. Activity Coefficients of Nitric Acid. F. Hartmann and P. Rosenfeld. *Zeits. f. phys. Chem.* 164. *Abt.A.* 5. *pp.* 377–385, *May*, 1933.—Divergences exceeding the limits of experimental error being shown by the cryoscopic measurements of nitric acid solutions made by various experimenters, a fresh series of measurements has now been made to cover the concentration range 0·03–6·6 mol. per 1000 gm. of water. The results agree well with those of Abel, Redlich and Lengyel [see Abstract 1775 (1928)] and are used as the basis of calculations of the activity coefficients of the acid at about the freezing point, at 0°, and at 25° for solutions containing from 0·001 to 6·0 mol. of the acid per 1000 gm. of water. These results are tabulated. T. H. P.

3191. Moving Boundary Method for the Determination of Transport Numbers. G. S. Hartley and J. L. Moilliet. *Roy. Soc., Proc.* 140. *pp.* 141–158, *April* 1, 1933.—The fundamental relations between transport number, mobility, and equivalent conductivity of a radical are developed for the electrolytes considered. The terms are defined independent of any assumption of the state of dissociation or aggregation. Experimental work on both rising and falling boundaries, and particularly the effects of temperature are discussed. F. J. B.

3192. Ludwig-Soret Effect and Ionic Mobility in CuBr-AgBr Mixed Crystals. H. Reinhold and R. Schulz. *Zeits. f. phys. Chem.* 164. *Abt. A.* 3–4. *pp.* 241–276, *April,* 1933.—An equation is deduced theoretically for the relation between the Ludwig-Soret effect and the relative ionic mobility in mixed crystals, and the system CuBr-AgBr has been investigated to check this equation. Contrary to what is found with other systems of mixed crystals, the Ludwig-Soret effect in this case changes its sign on alteration of either concentration or temperature. In agreement with the equation deduced, the temperature coefficient of the transference numbers also changes its sign in the same region of concentration and temperature as the Ludwig-Soret effect [see Abstract 2128 (1931)]. T. H. P.

3193. Mechanism of the Hydrogen-Oxygen Electrode. K. Bennewitz and W. Neumann. *Zeits. f. phys. Chem.* 164. *Abt. A.* 3–4. *pp.* 277–294, *April,* 1933.—The potential of the hydrogen-oxygen electrode was investigated from the standpoint of the composition of the gaseous mixture. Two types of curve were obtained when the e.m.f. was plotted against the pH value. One type was observed with platinised platinum, the second type sometimes on platinised platinum, but always on smooth platinum. Type 1 was interpreted by the early theory of Langmuir, which demands the formation of oxide, and type 2 by a theory of Erdey-Gruz and Volmer. F. J. B.

3194. Occlusion of Hydrogen by Iron. F. Körber and H. Ploum. *Zeits. f. Elektrochem.* 39. *pp.* 252–255, *April,* 1933.—Iron in the form of wire 0·6 mm. thick was annealed in a stream of electrolytic hydrogen and then kathodically charged with hydrogen by the electrolysis of $1N$ sulphuric acid. The quantity of hydrogen taken up by the iron was determined by heating at 400° C. and collecting the gas by a mercury pump. It was shown that in charging iron with electrolytic hydrogen, the hydrogen only entered the iron when certain catalysts were present. When extremely pure iron was employed no hydrogen entered into the iron. F. J. B.

3195. Use of Tungsten-Nickel Electrode System in Neutralisations. N. H. Furman and G. W. Low. *Am. Chem. Soc., J.* 55. *pp.* 1310–1315, *April,* 1933.—Electrodes consisting of tungsten and nickel wire were used in cells for the electrometric titration of acids and bases. The system was shown to be satisfactory in the titration of weak bases with strong acids. In the titration of weak acids or polybasic acids the system appeared to be of little use. F. J. B.

3196. Electrochemical Properties of Photosensitive Electrodes in Copper Salts. R. Audubert. *Comptes Rendus,* 196. *pp.* 1386–1387, *May* 8, 1933.—Experiments are described with photosensitive electrodes such as Cu/Cu_2O, Cu/CuO, Cu/layer of phenosafranine, etc., in aqueous $CuSO_4$, which show that a Cu plate coated with a photosensitive substance behaves as one of pure Cu. Hence it is inferred that within limits of pH for which the photovoltaic e.m.f. is reproducible and the photosensitive substance unaltered, the electrode potential depends solely on an oxide-reduction process in which oxygen is concerned. C. A. S.

3197. New Silver Voltameter. M. Picard and A. Stampa. *Comptes Rendus,* 196. *pp.* 848–850, *March* 20, 1933.—The voltameter consists of an anode of a cylindrical piece of pure silver surrounded by a hemispherical glass vessel with lateral openings to prevent small fragments of silver dropping from the anode on the kathode, which is a hemispherical

Pt bowl. The authors found 1·01817 for the voltage of their cadmium standard cell, and 1·01830 for that of the cadmium cell of the Bureau of Standards. E. E. F. d'A.

3198. Cryoscopic Determination of Hydration of Ions in Solution. F. Bourion, E. Rouyer and (Miss) O. Hun. *Comptes Rendus,* 196. *pp.* 1015–1017, *April* 3, 1933.—To use the cryoscopic constants k^1 in a saline solution and k in pure water as observed with resorcincol, to determine the hydration of the ions, necessitates by reason of the association of resorcinol, the determination of k_3, the equilibrium constant of $3C_6H_4(OH)_2 \rightleftarrows [C_6H_4(OH)_2]_3$. This difficulty is avoided by assuming k_3 to be the same whether the solvent be pure water or a saline solution; in this way k being $18 \cdot 4\ k_3$ is 3·500. [See Abstract 493 (1928) and two following Abstracts.] C. A. S.

3199. Cryoscopic Determination of the Hydration of Ions of Potassium Chloride. F. Bourion and E. Rouyer. *Comptes Rendus,* 196. *pp.* 1111–1113, *April* 10, 1933.—With the assumption previously made [see preceding Abstract] the hydration of the ions deduced from MKCl and $0 \cdot 5M$KCl is respectively represented by KCl, $8 \cdot 6H_2O$ and KCl, $10 \cdot 2H_2O$. C. A. S.

3200. Cryoscopic Determination of Hydration of Ions of Sodium Chloride. F. Bourion and (Miss) O. Hun. *Comptes Rendus,* 196. *pp.* 1489–1491, *May* 15, 1933.—Determined in similar fashion the hydration of the ions in M and $0 \cdot 5M$ NaCl is represented respectively by NaCl, $13 \cdot 2H_2O$ and NaCl, $15 \cdot 6H_2O$. [See two preceding Abstracts.] C. A. S.

3201. Acid Strength and its Dependence on the Nature of the Solvent. W. F. K. Wynne-Jones. *Roy. Soc., Proc.* 140. *pp.* 440–451, *May* 3, 1933.—If K_r is the dissociation constant of acid A relative to that of a standard acid A_0, *i.e.*, the equilibrium constant of $A + B_0 \rightleftharpoons B + A_0$, where B, B_0 are the conjugate bases of A, A_0, $z\epsilon$, $z_0\epsilon$ the charges carried by B and B_0, r, r_0 the atomic radii of A and B,and of A_0 and B_0 respectively, both pairs assumed equal *inter se* and independent of the solvent, the change in K_r due to change ΔD in the dielectric constant of the solvent is given by $\Delta \log_e K_r / \Delta(1/D) = \epsilon^2/2kT \times (\pm 1/r \pm 1/r_0)$, the signs being $-\,+$, $+\,-$, or $+\,+$ according as A and A_0 are both uncharged, both carry a single positive charge, or A_0 uncharged and A carrying a single positive charge. These equations give satisfactory results when applied to the recorded dissociation constants of 20 different acids or bases in solution in water and methyl and ethyl alcohols, with benzoic acid and pyridinium ion as standards; as also when used as a means of calculating r. The relative strength of an acid consists therefore of (1) that due to electrical forces, and (2) intrinsic strength; this latter would be the strength in a solvent of infinite dielectric constant, and is deducible by extrapolation. The intrinsic strengths of 16 acids and 12 ammonium ions are thus deduced. C. A. S.

See also Abstracts 3159, 3181.

ELECTRONS AND PROTONS.

3202. Vaporisation Phenomena for Mercury Particles. R. Nestle and K. Schäfer. *Zeits. f. Physik,* 81. 9–10. *pp.* 700–701, *April* 7, 1933.—Replying to observations of Lustig and Reiss [see Abstract 1190

(1933)] on a paper by the authors, the latter reassert that their researches furnish no evidence in favour of the existence of electric charges of sub-electronic magnitude. The successive charges carried by one particle always differed by an integral multiple of the Millikan value. The much smaller values observed with stable particles were shown in the original work, to be illusory. In an *Addendum* **E. Regener**, *ibid*, *pp*. 701–702, says the researches of F. Ehrenhaft and his school portend to show that values of the electric charge on small particles sometimes fall below the Millikan value and the existence of a sub-electron is deduced. In other directions, however, where a sub-electron should be observed if it exists, experiment fails to support this view. The problem which remains therefore is to discover the causes of the observed apparent sub-electron charges.
W. S. S.

3203. Instrument for Converting Voltage Values into Hρ Values for Electrons. J. V. Hughes. *Phil. Mag.* 15. *pp*. 773–775, *April*, 1933.—Draws a right-angled triangle ABC, right-angled at B, and makes BC proportional to m_0c/e_m, and BA proportional to Hρ. Then he draws a circle round C with radius BC, cutting AC at D. Then DA is the voltage V/300 on the same scale. If a scale of Hρ be set up along BA and an arm be pivoted at C with a scale commencing at D marked along it, then the readings on the two scales at the point of intersection give corresponding values of Hρ and *V*/300 respectively.
E. E. F. d'A.

3204. Reflection of Electrons from Standing Light Waves. P. L. Kapitza and P. A. M. Dirac. *Cambridge Phil. Soc., Proc.*, 29. *pp*. 297–300, *May* 10, 1933.—When a beam of light falls on a mirror the direct and reflected rays form standing waves. It is shown that a pencil of electrons incident obliquely on the nodal surfaces of these standing waves will be partially scattered and in such a way that there is a reflected electron pencil for an angle of incidence determined by the Bragg law for crystal reflection with a lattice constant equal to $\frac{1}{2}\lambda$ where λ is the wave-length of the standing waves. The authors are concerned with the possibility of obtaining the reflected electron pencil experimentally and conclude that it might be done using an intense arc discharge to give a momentary flash of light. The theoretical interest is that the reflected electron is the result of stimulated scattering—an electron absorbs a photon from the direct optical beam and then under the stimulation of the reflected optical beam it re-emits the photon.
W. S. S.

3205. Scattering of Electrons in Thin Films. G. O. Langstroth. *Roy. Soc., Proc.* 140. *pp*. 159–178, *April* 1, 1933.—With the usual arrangement of an electron gun, a tilted scattering film and a moving Faraday cylinder as collector of the scattered beam, the angular distribution of electrons scattered between 65° and 160° by celluloid and aluminium films of various thicknesses has been determined for primary voltages between 8 and 25 kV. No electrons of less than 3·5 kV energy entered the measurements and single scattering conditions were fulfilled for the thinnest films. Also, the total number of electrons scattered back with more than 186 volts energy from various thicknesses of Al film was determined for primary voltages of from 8 to 24 kV, while the fraction of the incident electrons transmitted by a thick Al foil (7×10^{-5} cm.) was determined for primary voltages of from 4 to 20 kV. All the results showed systematic deviations from the predicted results for elastic scattering. The deviations are believed to be due to the presence of a considerable number of high speed secondary electrons, possessing at least half the primary energy and coming mainly from within small distances from the film surface. The probability of production and escape of fast secondary electrons is much smaller for celluloid than for Al. The presence of these secondary electrons is sufficient to explain the anomalous intensity relations observed in electron diffraction experiments with thin films. When the foregoing factors are taken into account, the departure from Wentzel's scattering law for single elastic scattering is not more than 10 % at intervals of 20°. F. C. C.

3206. Energy of the Beams in Electron Diffraction. F. C. Poultney and R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 387–390, *April*, 1933.—The experiment of G. P. Thomson, using a magnetic field to determine the velocities of electrons diffracted by passage through a thin film is repeated. Greater resolving power is obtained by using 90° deviation, when the circular rings become elliptical but remain symmetrical about the central spot. No trace of electrons whose energy is less than that of the main beam by the amount lost in X-ray excitation is found and the velocities of the diffracted electrons are considered to be the same as those of the incident electrons to within 0·3 %. F. C. C.

3207. New Type of Apparatus for Experiments in Secondary Electron Diffraction. W. T. Sproull. *Rev. Sci. Instruments,* 4. *pp.* 193–196, *April*, 1933.—By means of a special arrangement of the filament, grid, slits, target and collector, together with a suitable magnetic field, an apparatus is devised which has two advantages over apparatus of the usual type : (1) The secondary beams diffracted from the crystal at angles θ with the normal as small as zero can be analysed even if the primary beam is incident normally upon the surface of the crystal, whereas in the usual apparatus the lower limit for θ is about 15° ; (2) the contact potential between the filament and the other parts of the electron gun no longer need be considered in estimating the actual velocity of the primary electrons which strike the target. A disadvantage, however, is that in order to perform experiments in which the bombarding potential is varied by small steps, corresponding re-adjustments of the magnetic field must be made. F. C. C.

3208. Diffraction of Low-Speed Electrons by a Tungsten Single Crystal. W. T. Sproull. *Phys. Rev.* 43. *pp.* 516–526, *April* 1, 1933.—The (1–1–2) and (1–0–0) planes of a tungsten crystal were bombarded at normal incidence with primary electrons and the intensity of the full-velocity secondary beams measured as a function of azimuth, co-latitude θ, and primary voltage. A new magnetic deflection method of analysing the secondaries permitted observations at co-latitudes down to zero. The crystal was outgassed for 1550 hours at temperatures up to 1600° C. at pressures of 10^{-7} mm. of Hg or less. Strong sharp beams were observed in one particular azimuth of the (1–1–2) plane at all wave-lengths which were used and were found to be governed in every case by the volume equation $n_2\lambda = d/6^{\frac{1}{2}} + 2(d/6^{\frac{1}{2}}).\ \sin\ (30–\theta)$ and in no case by the surface equation. This is the first time that such a pronounced deviation from the usual theory has been observed. The values obtained for W_a were unusually consistent. The final average experimental value was 5·52 volts, which combined with the photoelectric and thermionic data yields a value for W_i of about 1 volt. This is in disagreement with Sommerfeld's theory which predicts $W_a = 5 \cdot 7$ volts. A few beams of the usual type obeying both interference equations were observed in other azimuths of the (1–1–2) plane. They were all quite broad, however, and consequently no attempt was made to estimate W_a from them. Beams were found in the case of the (1–0–0) plane which could be detected for various wave-lengths within the immediate neighbourhood of their predicted location and which showed a tendency to vary in latitude in obedience to the volume equation, but became too weak to observe if the wave-length chosen was very far from the predicted value. Slight variations in the angle of incidence were found to have a very great effect on the observations. Some of those portions of the observations which differ from typical results obtained in similar experiments on other metals, can be correlated qualitatively with the peculiarities of the tungsten crystal lattice. F. C. C.

3209. Diffraction of Electrons by Metal Surfaces. L. H. Germer. *Phys. Rev.* 43. *pp.* 724–726, *May* 1, 1933.—Fast electrons scattered from polished metal surfaces do not form diffraction patterns. A strong Debye-Scherrer pattern is produced, however, by electrons scattered from a surface which has been mechanically roughened in such a manner that electrons are able to pass directly through projecting irregularities. Small ridges extending from wires, which have been drawn through an imperfect die, also give rise to a diffraction pattern. These experiments indicate : (1) that there is no considerable layer of amorphous material (Beilby layer) on a polished metal surface, and (2) that Debye-Scherrer diffraction patterns are formed only by transmitted electrons. Fast electrons scattered at a small glancing angle from an etched polycrystalline surface form a diffraction pattern if the surface appears matt or roughened, but no pattern is formed if the surface shows metallic lustre. Here again diffraction patterns appear to be produced only by transmission. A probable explanation is given for the fact that diffraction rings are not formed by electrons scattered from smooth polycrystalline surfaces. AUTHOR.

3210. Electron Diffraction in Gaseous SF_6, SeF_6 and TeF_6. H. Braune and S. Knoke. *Zeits. f. phys. Chem.* 21. *Abt.B.* 4. *pp.* 297–309, *May*, 1933.—By means of diffraction data when a beam of electrons passes through the above gases, molecular measurements have been obtained. The structure of these hexafluorides appears to be octahedral with respect to the central atom and the atomic distances are : SF_6, 1·56 Å ; SeF_6, 1·67 Å ; and TeF_6, 1·82 Å. H. H. Ho.

3211. Diffraction of Electrons in Mercury Vapour. Part II. F. L. Arnot. *Roy. Soc., Proc.* 140. *pp.* 334–344, *May*, 1933.—Earlier work on the angular distribution of elastically scattered electrons in mercury vapour [see Abstract 2785 (1931)] has been extended to larger angles and to lower electron energies. Results are given over an angular range of 20° to 175° for seventeen different values of the energy of the primary electron beam between 2 volts and 200 volts. The results obtained above the ionisation potential show several diffraction maxima and minima. The scattering curves for electrons having energies between the ionisation potential and about 50 volts rise steeply at angles near 180°, showing that there is considerable backward scattering for electrons of these energies. Investigations are at present in progress with other gases and vapours. AUTHOR.

V. 19

3212. Diffraction of Kathode Rays by Mica. K. Shinohara and K. Matukawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 424. *pp.* 21–25, *May,* 1933. *In English.*—Kikuchi's experiments are continued using monochromatic kathode rays with energies from 27 to 57 kV and a comparatively thick sheet of mica. Six photographs of the diffraction patterns are reproduced. No forbidden line is present and the effects are adequately explained by theories given previously by Kikuchi and by Bethe. F. C. C.

See also Abstracts **2696, 2911, 2927, 2928, 2929, 2991, 3142, 3222, 3229, 3269.**

ELECTROSTATICS.

3213. Action at a Distance in Electricity. H. Abraham. *Comptes Rendus,* 196. *pp.* 1094–1095, *April* 10, 1933.—Considers an ideal experiment in which an electrometer with plane discs is placed in a vessel which can be filled with a dielectric. Reaches the conclusion that electric forces can only be calculated by the laws of action at a distance, if the coefficient is the same as that in a vacuum. The influence of the medium must be dealt with by calculating the effect on the polarised elements of the medium, and taking account of the pressure exerted by the latter on the immersed bodies. J. H. A.

3214. Capacity of Electrometers. H. Benndorf. *Phys. Zeits.* 34. *pp.* 335–338, *April* 15, 1933.—Arises out of the paper by Dees on the same subject [see Abstract 2590 (1932)]. Discusses first whether the quantity measured by Dees can legitimately be called the capacity of the electrometer, and gives a simple theory of the thread electrometer, which is supported by means of the experimental data given by Dees. J. H. A.

3215. Sources of Error in Capacity Measurements with Sensitive Electrometers. E. Sienkiewicz. *Phys. Zeits.* 34. *pp.* 376–380, *May* 1, 1933.—Incorrect values of the capacity of an Elster and Geitel string electrometer were obtained, and different values with positive and negative charges, when the electrometer was sensitive to a single volt. Correct values could be obtained only when the contact potentials were ascertained. It appears that these contact potentials are variable and change with the value of the charge on the electrometer, so that errors of more than 100 % may be introduced. Harms's method of determining capacity, which utilises charging by induction, is free from the effects of contact potential. F. C. C.

3216. Parallel Plate Condenser with Negative Capacity. H. Benndorf. *Zeits. f. Physik,* 82. 5–6. *pp.* 397–403, *May* 8, 1933.—A parallel plate condenser, the separation of the plates of which is governed by springs suspending the upper plate, is a simple example of a "negative capacity," defined by the author as dQ/dV. By keeping the charge constant and letting the plates move together, thus decreasing the potential difference, such a condenser may have any capacity between $+\infty$ and $-\infty$. The average capacity, Q/V, is always positive and increases with increasing charge. If V is kept constant the capacity is always positive and for a critical potential difference the capacity is infinite. This critical potential difference is so large that the separation between the plates is reduced to $\frac{2}{3}$ of its value when the plates are uncharged. For higher values of V the equilibrium is unstable and the plates are drawn together. J. E. R. C.

3217. H.T. Electrostatic Induction-Electrometer. A. Hinzpeter. *Ann. d. Physik*, 17. 1. *pp.* 41–64, *May*, 1933.—Description of an instrument based on the principle of partial induction. If of appropriate dimensions it can measure voltages of any large value. By a compensation method it can be used for the measurement and recording of voltage variations as low as 0·1 in a thousand of the main voltage. Examples of experimental results. A. D.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3218. Hall Effect in Beryllium. A. Ciccone. *Accad. Lincei, Atti*, 17. *pp.* 305–308, *Feb.* 19, 1933.—Measurements are made on a specimen of beryllium of purity 99·5 %, and the value of the Hall coefficient is found to be + 0·0024. J. J. S.

3219. Influence of a Transverse Magnetic Field upon the Resistance of Liquid Metals. I. Fakidow and I. Kikoin. *Phys. Zeits. d. Sowjetunion*, 3. 4. *pp.* 381–392, 1933. *In English.*—The influence of a magnetic field upon the resistance of a liquid metal alloy KNa is studied. In a liquid metal a change of resistance in a magnetic field is observed. The relative change of the resistance $\Delta r/r$ beginning with fields of about 1000 gauss and upwards is linearly dependent upon the intensity of the field. AUTHORS.

3220. Conductivity of Electronic Semi-Conductors in a Magnetic Field. M. Bronstein. *Phys. Zeits. d. Sowjetunion*, 3. 2. *pp.* 140–145, 1933. *In English.*—A theoretical formula for the dependence of the conductivity of electronic semi-conductors on the magnetic field is given and discussed. J. J. S.

3221. Change of Resistance of a Semi-Conductor in a Magnetic Field. J. W. Harding. *Roy. Soc., Proc.* 140. *pp.* 205–222, *April* 1, 1933.—A mathematical paper in which A. H. Wilson's theory of semi-conductors is applied to the problem of the change of resistance of a semi-conductor in a magnetic field. The theory gives the right form of curve required to explain the experimental results both for low and high fields, and yields the correct order of magnitude for the effect. The variation of the change of resistance with the temperature given by the theory is in the right direction, *i.e.*, the change of resistance decreases with increasing temperature, and the bend in the curve is shifted to lower field strengths. J. J. S.

See also Abstract 3163.

MAGNETISM AND ELECTROMAGNETISM.

3222. Electromagnetic Field of a Moving Electrified Sphere and its Radiationless Orbits. G. A. Schott. *Phil. Mag.* 15. *pp.* 752–761, *April*, 1933.—It is generally assumed that an electrified body in accelerated motion necessarily loses energy by radiation at a rate proportional to the square of its velocity. The author claims to have discovered a case where this assumption is certainly false. It is the dielectric, *e.g.*, ebonite, of a spherical condenser. He shows mathematically that if the centre of such a uniformly and rigidly electrified sphere describes a closed orbit of any form with a suitably chosen period, and the sphere rotates with such an angular velocity that every point of it describes an equal and parallel orbit, then the electric field due to the sphere at a sufficient distance is a static field, and therefore no energy will be radiated to infinity. The motion of the sphere must be one of pure translation without any spin. Discusses the application of this conception to electrons, protons and neutrons. E. E. F. d'A.

3223. Atomic Moments in Ferromagnetic Metals and Alloys with Non-Ferromagnetic Elements. E. C. Stoner. *Phil. Mag.* 15. *pp.* 1018–1034, *May*, 1933.—A summary is given of the experimental results for the magnetic moment per atom in ferromagnetic metals at low temperatures, and of the Sadron results for the change in the average atomic moment due to the substitution of foreign elements. The magnetic moment is due almost entirely to electron spin, but the atomic moments are not in general integral multiples of the Bohr unit. The unsatisfactory features in previously suggested interpretations of the experimental values are pointed out. The view is put forward that the observed values of the atomic moment in ferromagnetic elements correspond to an equilibrium resulting from the normal tendency to antiparallel setting of the spins of interacting electrons in a metal being opposed by the tendency to parallel setting, due to the interaction integral being positive. A formal treatment of the equilibrium with relevant data is given. It is shown that in simple cases, the substitution of foreign elements will result in a decrease of total moment (except when the interaction is positive), the decrease in moment per substituted atom in Bohr units being equal to the valency of the atom. This holds closely for Cu, Mn, Al, and Sn in Ni. In other cases only rough predictions can be made, but the experimental results as a whole are compatible with the outlook suggested. H. H. Ho.

3224. Law of Discontinuous Distribution of Ferromagnetic Curie Points. Part I. Rôle of the Distance between Magnetic Atoms. R. Forrer. *J. de Physique et le Radium*, 4. *pp.* 109–117, *March*, 1933.—The supposition of a magnetic multiplet [see Abstract 780 (1930)] and the introduction of an electric multiplet with the same symmetry as the magnetic multiplet, and placed, like it, in relation to the lattice, in conjunction with a hypothesis of " effective contact " between the orbits of two neighbouring electric multiplets lead to the result that the ferromagnetism of iron proceeds from six neighbouring atoms. The distance between two neighbouring atoms is called the effective distance, and this distance (2·8 Å) is to be found in the ferromagnetic compounds of iron and manganese. The effective distance for cobalt and nickel is 2·5 Å. When the atomic distance is distinctly less than the effective distance, the substance has constant paramagnetism ; when it is greater, the substance has variable paramagnetism. G. E. A.

3225. Law of Discontinuous Distribution of Ferromagnetic Curie Points. Part II. The Law and its Verification. R. Forrer. *J. de Physique et le Radium*, 4. *pp.* 186–209, *April*, 1933.—The hypothesis is made of an orientated electronic lattice formed from N electrons per atom. Each electron forms an orbit which touches neighbouring orbits. The contacts, called effective contacts, are broken at the Curie point. The number N of contacts per atom can be determined from a knowledge of the magnetic multiplet, and it is found that N is proportional to θ^2. Discussion of ferromagnetic materials shows that the majority of the Curie points are associated with equal numbers of contacts. No ferromagnetic compound has a Curie point below 28° C. ($N=1$). The application of the above law to several ferromagnetics of which the crystal lattice is known allows of the determination of their orientated electronic lattice, and in certain cases the axis or the plane of easiest magnetisation. [See preceding Abstract.] G. E. A.

3226. Magnetic Properties of the Iron-Nickel Alloys under Hydrostatic Pressure. R. L. Steinberger. *Physics,* 4. *pp.* 153–161, *April,* 1933.—A series of well annealed iron-nickel alloys in nominal steps of 10 % Ni, including pure iron and pure nickel, has been examined for the effect of pressures, up to 12,500 kg./cm.², on the magnetic flux density. The application of pressure to a well annealed specimen causes a relatively large change in flux, usually a decrease and an incomplete recovery on release of pressure. The recovery is reversible in the sense that the same curve of flux change is traced with each series of pressure applications, provided the measuring pressure does not exceed that first applied. The 30 % Ni alloy is rendered nearly non-magnetic by a pressure of 12,000 kg/cm². In the remaining metals pure iron exhibits the greatest and 90 % Ni the smallest pressure change of flux. At constant field the different alloys exhibit various types of pressure changes of flux; linear, nonlinear and types exhibiting hysteresis. AUTHOR.

3227. Theory of Hysteresis Losses. N. Akulov. *Zeits. f. Physik,* 81. 11–12. *pp.* 790–794, *April* 18, 1933.—In continuation of previous work [see Abstract 992 (1931)], the author shows that the curve of magnetisation (B–H), in addition to having branches associated with reversible spin rotation, also has branches associated with irreversible rotation of spin relative to the crystal axes. Methods of calculating maximum coercivity and hysteresis losses and the effect of stresses upon the form of the magnetisation curve are discussed. J. S. G. T.

3228. Magnetisation of Ferromagnetic Crystals. F. Bitter. *Phys. Rev.* 43. *pp.* 655–660, *April* 15, 1933.—In a previous article [see Abstract 1217 (1933)] a function $E\,\theta$ is discussed. This function gives the energy of a crystal as a function of the direction of magnetisation. The present paper contains photographs of plaster models representing $E\,\theta$ for an undistorted crystal of nickel, for an undistorted crystal of iron in zero applied field, and in a field of 100 oersteds parallel to the [100], [110], and [111] axes respectively, and for an iron crystal distorted by compression and extension along the above mentioned axes. Assuming that a crystal is magnetised to saturation in the direction in which $E\,\theta$ has a minimum, magnetisation curves for crystals distorted as mentioned above are calculated and illustrated. AUTHOR.

3229. Interatomic Electrons in Crystal Lattices. R. Forrer. *Comptes Rendus,* 196. *pp.* 1097–1099, *April* 10, 1933.—The author attributes ferromagnetic properties to an electronic network of orientation [see Abstract 3438 (1932)]. The number of contacts, *N* per atom, of the orbits of this network has a certain relation with the temperature of the Curie point. This relation is $T - FN^{\frac{1}{2}}$. In the case of iron, each atom has four neighbours in the plane (001). There being three such planes, each atom makes 12 effective contacts with its six neighbours. This gives a factor $F - 301$. The centres of the atoms are 2·86 Å apart, a distance which the author calls the effective distance of ferromagnetism. In magnetite, the atoms are arranged on a hexagonal plan with an interatomic orbit in the centre of each hexagon. The number of contacts of each

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atom is 8. The author further shows that the number of contacts calculated in this way agrees with that derived from the fusing point.
E. E. F. d'A.

3230. Magnetism and Disturbances of the Crystal Lattice. X-Ray Investigations of α-Iron. F. Regler. *Zeits. f. Physik*, 82. 5–6. *pp.* 337–354, *May* 8, 1933.—By experiments on iron and steel specimens previously strained, it is shown that the crystal lattice of ferromagnetic bodies undergoes a change in a magnetic field. The change depends on the magnitude and nature of the magnetic field, and on the state of strain of the material under test. The X-ray methods of the author [see Abstract 4047 (1932)] were employed to determine the amount of lattice disturbance and lattice rotation. G. E. A.

3231. Magnetic Properties of Liquid Ozone. P. Lainé. *Comptes Rendus*, 196. *pp.* 910–913, *March* 27, 1933.—The magnetic properties of liquid ozone which can be obtained in a very pure and stable state, were studied by observing the difference in meniscus height in the two vertical branches of a tube in the form of a rectangular frame, one meniscus being placed in a very strong, the other in a weak magnetic field. A slight difference of level was observed consistent with weak paramagnetism of liquid ozone, but the presence of a few tenths of a per cent of oxygen would vitiate this conclusion. Arrangements were then made to observe the difference of meniscus level at two temperatures (80·5° K. and 88·5° K.). The same result was obtained at both temperatures. If any oxygen present behaved in the same way as traces of oxygen in liquid nitrogen and obeyed Curie's law, then it would follow that ozone is paramagnetic with a susceptibility independent of temperature. Further work using known mixtures of oxygen and ozone is in prospect. W. S. S.

3232. Diamagnetism of Carbon Tetrachloride, Benzene and Toluene at Different Temperatures. G. F. Boeker. *Phys. Rev.* 43. *pp.* 756–760, *May* 1, 1933.—An account is given of experiments on the variation, with temperature, of the diamagnetism of benzene, toluene and carbon tetrachloride. The results indicate that the mass susceptibilities of these liquids decrease only slightly, if at all, with increasing temperatures; the change was less than 1 % in each case. [See Abstract 1210 (1933).]
AUTHOR.

3233. Definition of Magnetic Field. H. Abraham. *Comptes Rendus*, 196. *pp.* 908–910, *March* 27, 1933.—The writer is concerned with the determination of the force exerted on a magnetised medium carrying current, by an external magnetic field. Maxwell in his treatise and J. J. Thomson (1898) have given different formulæ and although these are equivalent if consistently applied, it is shown that Thomson's formulæ are more obvious in use and less likely to be misapplied. W. S. S.

3234. Electromagnetic Equations. F. Prunier. *Comptes Rendus*, 196. *pp.* 1007–1009, *April* 3, 1933.—A mathematical note on Maxwell's electromagnetic equations. J. J. S.

3235. Influence of the Intensity of Magnetisation upon the Modulus of Elasticity and Damping of Natural Vibrations of Ferromagnetic Materials. O. v. Auwers. *Ann. d. Physik*, 17. 1. *pp.* 83–106, *May*, 1933.—The subject is of twofold interest: (*a*) in relation to the crystalline lattice structure of the material and its consequent influence upon its elasticity; (*b*) in connection with piezoelectric phenomena where magnetostriction plays a part in determining resonance. The paper outlines an experimental method for giving both free and damped vibrations in rods of the various ferromagnetic materials placed in magnetic fields of varying intensities. The alteration of the elasticity modulus and the damping in relation to the field strength and induction was measured for nickel rods (hard, soft, and very soft), soft nickel tube, permalloy, soft iron and hard steel. The alteration of the modulus of elasticity is greater for softer materials and becomes smaller with decreasing magnetostriction. The damping of magnetically saturated ferromagnetics reaches a definite minimum and the elasticity modulus variation reaches a corresponding maximum. The damping minimum and the maximum of the magnetoelastic conditions of induced alternating potentials coincide. Hysteresis is noted both for damping and elasticity variations whenever the induction falls below the maximum. Longitudinal tension or stress disturbs the elastic effect considerably. The paper is fully illustrated with diagrams, curves and tables. S. G. B.

3236. Influence of Elastic Extension of Ferromagnetic Material at the Curie Point. M. N. Michejew. *Phys. Zeits. d. Sowjetunion,* 3. 4. *pp.* 393–398, 1933. *In German.*—The Curie temperature of a Ni–Cu alloy is measured. The wire investigated was stretched by various loads and it was found that within the limits of experimental error the Curie temperature remains the same under the various different tensions. Experimental details and tables of results are given. S. G. B.

3237. Apparatus for Magnetic Testing at High Magnetising Forces. R. L. Sanford and E. G. Bennett. *Bureau of Standards, J. of Research,* 10. *pp.* 567–573, *April,* 1933.—Description of an apparatus suitable for general magnetic testing in the range of values of magnetising force from 100 to 1000 oersteds. Specimens of rectangular cross-section from 0·5 in. (1·27 cm.) to 1·5 in. (3·8 cm.) in width and any thickness up to 0·75 in. (1·9 cm.) can be tested with an accuracy estimated to be within 2 %. The apparatus is convenient and simple to operate, and does not heat the specimen. AUTHORS.

3238. Compact Electromagnet for General Purposes. L. F. Bates and B. J. Lloyd-Evans. *Phys. Soc., Proc.* 45. *pp.* 425–432; *Disc.,* 433, *May* 1, 1933.—An electromagnet suitable for many branches of research work is described. Special attention is paid to the construction of the coils, which are cooled by the circulation of oil. Some tests and experiments with a magnetic potentiometer are described. AUTHORS.

See also Abstracts 2787, 2932, 3174, 3183, 3267.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3239. Calculations Relating to the Electrical Transport of Material in the Living Organism. R. Fürth. *Kolloid Zeits.* 63. *pp.* 215–220, *May,* 1933.—The transport of living tissue in animals and vegetable organisms is largely of a colloidal nature and is very complicated at the various surfaces, which are the seat of an electrical double layer and a corresponding potential difference of the order of 10-100 millivolt. It is known that electrical variations occur during the function of living muscle in respect to the electrical fields. Cataphoresis and electroosmosis play a part in the movement of liquids in hollow spaces, *i.e.*, veins, etc. Both these effects play an important rôle, but, in respect to the circulation of fluids in animal and vegetable tissues, electroosmosis plays the most

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important part. The present paper is a mathematical treatment regarding the electrical changes during such transport, in relation to the bioelectrical potentials and current values. It is shown that, under biological conditions, the order of current in relation to electroosmosis which would be theoretically required is 100,000 times smaller than the actually observed currents and that the energy values differ in the same order. The calculations are based upon the assumption that the internal resistance of flow is overcome by the electrical energy. Concentration of the fluid constituents occurs in some regions and deconcentration in other regions. A special example of the concentration of urine is cited, in respect to the biological electrical and heat changes. B. J. L.

3240. Anti-Diffusion Filters. R. Imbert. *J. de Radiologie et d'Electrologie,* 17. *pp.* 233–240, *April,* 1933.—An account is given of the difficulties encountered in the construction of anti-diffusion grids of the Potter-Bucky type, when complete freedom from grid markings on the radiograph is required. The minimum velocity of grid elements for such freedom is calculated. A description is given of a reduced model of a grid designed to overcome most of the difficulties. The chief features are: (*a*) grid elements consisting of closely packed lead tubes; (*b*) high-speed "epicyclic" motion, thus avoiding the stationary centre of ordinary circular grids; (*c*) driving mechanism outside the field of radiation. The anti-diffusion properties of such a filter are independent of the time of exposure, and avoid stroboscopic effects. Suggestions are made for a commercial model. J. E. R.

3241. Application of Thin-Film Resistances to the Measurement of Voltage and Power in X-Ray Tubes. G. W. Bowdler. *Brit. J. of Radiology,* 6. *pp.* 266–276; *Disc.,* 276–278, *May,* 1933.—The requirements of a h.t. measuring resistance are discussed and a description is given of the construction of a 100 megohm resistance for use up to 100 kW. This consists of twenty-five 4-megohm "grid leak" units assembled in a glass tube filled with oil and provided with an oil circulating system for cooling. Measurements of the change of resistance with time and with voltage and of the "impurity" or phase error show that the resistance is stable and may be used on direct or alternating voltage of power frequency. The use of a high resistance in conjunction with a suitable l.t. measuring instrument for measuring peak, RMS or mean values of voltage and also the power applied to X-ray tubes is considered in a few typical examples. W. E. P.

3242. Transmission of Light by a Flexible Unit of Quartz. H. Dejust and E. Perrin. *Rev. d'Optique,* 11. *pp.* 433–438, *Nov.,* 1932.—The flexible unit, designed to localise the action of ultra-light rays, consists of portions of a cylindrical quartz rod held closely together by a rubber tube. Measurements of the light transmitted by this unit bent at angles varying from 0° to 90° were made by a photographic method. When the unit is bent at 30° the transmission is 70 % of that of the straight unit. The transmission of a conical quartz rod was compared with that of a cylindrical rod having the same diameter as the base of the cone. The transmission is about 50 % of that of the cylindrical rod when the surfaces in contact with the photographic plate are in the ratio of 1 to 7·2. W. E. P.

3243. Quality Determination of X-Rays: Half Value Layer as a Practical Method of Estimating the Quality of X-Rays. W. H. Meyer. *Radiology,* 20. *pp.* 286–294; *Disc.,* 295–296, *April,* 1933.—The practical requirements in X-ray therapy, in respect to measurement of radiation quality are discussed. Such data cannot be supplied by the manufacturers of the apparatus, as they are only valid under actual conditions of operation. Errors are far more important in X-ray therapy than in X-ray diagnostic radiography, as, in the case of error in the latter application, only waste of film material can result. Any practical method of measurement should be simple, so that the actual radiologist can easily perform it, who is not justified, in relation to his patient, in relying upon measurements carried out by physicists, technicians, etc. Methods of measurement of quality are discussed and that depending on measurement of voltage is considered unsuitable as compared with the measurement of the actual radiation. Measurements of radiation quality are discussed and the half value layer is considered the most simple and suitable, when this measurement is effected photographically. In the *Discussion*, **Trostler** commented upon the importance of such measurements in respect to legal mal-practice actions. B. J. L.

3244. Effect of Radon on Cell Growth. A. Foà. *Accad. Lincei, Atti,* 17. *pp.* 578–582, *April* 2, 1933.—The author describes a method he devised for separating the effect of the α-particles from that of the β- and γ-rays when studying the action of radon on a single cell or on groups of cells. He gives a description of some of the results observed during the course of the work. J. W. T. W.

3245. New Electroscope for Hospital Use. L. G. Grimmett. *Brit. J. of Radiology,* 6. *pp.* 279–287, *May,* 1933.—An instrument is described, a development of a previous one [see Abstract 4392 (1932)], which can be used with a minimum of manipulative skill in a hospital radium department. The arrangement is simple, consisting of a large ionisation chamber, a high resistance and a Lindemann electrometer. In this form the activity of γ-ray sources can be read off directly with ease. For a higher degree of accuracy the high resistance can be detached. The instrument can also be used for α-ray and β-ray estimations. J. E. R.

3246. Biological Effects of E.H.F. Electromagnetic Radiation. J. W. Schereschewsky. *Radiology,* 20. *pp.* 246–253, *April,* 1933.—The development of h.f. oscillations, for wireless applications, has led to investigation of their possible effects on living matter, the first investigation in this respect being carried out in France in 1924 upon plant tumours and in the U.S.A. by the present author upon small animals, particularly mice. When mice are exposed to high frequency radiations, in a manner described, severe symptoms develop leading to death, or lesser symptoms, such as necrosis of the ears. A definite selectivity as regards frequency was found and the lethal effect was most marked between 66,000,000 to 18,000,000 ∼. Further experiments were carried out by the author upon mouse sarcomata and, with a large number of mice (about 400), 25 % recovered from their tumours. Rous sarcomata have also been treated in chickens, but only retardation of the growth was possibly present. Further experiments have been carried out on rat sarcomata. In 1928, in the General Electric Company's Research Laboratory, Whitney observed a rise of oral temperature in operators and variations of temperature of solutions, varying with the actual concentrations. Observations have been in two directions, (1) the study of the heating of electrolytes in high frequency fields and (2) investigations of the use of the high frequency electrostatic field as a means of producing artificial fevers for therapeutic purposes in human beings.

In reference to these investigations previous work is reviewed, and a fairly extensive Bibliography is given. B. J. L.

See also Abstracts 2687, 2876, 2909, 2916.

OSCILLATIONS.

3247. Maintained Oscillations. E. Hochard. *Comptes Rendus,* 196. *pp.* 905–906, *March* 27, 1933.—Experimental arrangements are described whereby electrical oscillations can be maintained with the aid of a photoelectric cell. The latter is in series with a high resistance R and an h.t. battery. A condenser C is placed across the cell terminals. In either the main circuit or in the condenser circuit a mirror galvanometer is inserted and the beam of light from the galvanometer mirror falls on the window of the cell when no current is passing. With this arrangement maintained electrical oscillations can be generated, of various wave forms controlled by C, R, the intensity of the light beam, and the periodicity and damping of the galvanometer. W. S. S.

See also Abstract 2132.

PHOTOELECTRICITY.

3248. Distribution of Photoelectrons in the M-Layer of Atoms Resembling Hydrogen. J. Kreisler. *Acta Physica Polonica,* 2. 1. *pp.* 7–22, 1933. *In German.*—Calculates a formula of 22 terms for the distribution of photoelectrons in the M-shell of the H and similar atoms. One portion of these terms refers to the M_{I} electrons, another to the $M_{II} + M_{III}$ electrons, and a third to the $M_{IV} + M_{V}$ electrons, which can only be separated by relativity considerations. The first portion is very similar to the formulæ given by Sommerfeld and Schur for the distribution of photoelectrons in the K-shell and in the M-shell. E. E. F. d'A.

3249. Theory of the Energy Distribution of Photoelectrons. L. A. DuBridge. *Phys. Rev.* 43. *pp.* 727–741, *May* 1, 1933.—Because of the thermal energies of the electrons in a metal there can be no *sharply defined* maximum emission energy of photoelectrons, as was once supposed. On the basis of the Sommerfeld theory and the Fermi-Dirac statistics, expressions are derived for the form of the energy distribution and current voltage curves in the vicinity of the apparent maximum energy. The method used is similar to that used by Fowler in computing the total emission current. In Part I the energies normal to the emitting surface are considered. At 0° K. the theoretical current-voltage curve is a parabola tangent to the energy axis at V_{max}, while for higher temperatures it approaches the axis asymptotically. In Part II the treatment is extended to the total energy of emission and in this case the current-voltage curve at 0° K. is a parabola concave towards the voltage axis and cutting it at a large angle. At higher temperatures there is an asymptotic approach. Even at room-temperature there is an uncertainty of several hundredths of a volt in V_{max}, though the theory yields a method of determining the maximum energy which would be observed at 0° K. Both parts of the theory are found to be in agreement with new experiments on molybdenum. The bearing of the theory on the photoelectric determination of *h* is discussed. AUTHOR.

3250. Action of Periodically Varying Light on a Metallic Plate. Q. Majorana. *Accad. Lincei, Atti,* 17. *pp.* 255–256, *Feb.* 19, 1933.—Deals with the action of interrupted light on a lamp-blacked disc, which may be partly due to heat, and describes a new method of compensating the photoelectric action. E. E. F. d'A.

3251. New Photoelectric Effect. A. Etzrodt. *Phys. Zeits.* 34. *pp.* 338–340. *April* 15, 1933.—The writer has repeated similar experiments to those in which Majorana obtains evidence of a new photoelectric effect when light falls on thin metal foils [see Abstract 5223 (1932)]. He finds that the effects can be accounted for by a thermal change of resistance. although he has not worked with very thin foils. In reply **Q. Majorana** states that Etzrodt has not considered the sign of the alteration of resistance nor has he worked with nearly as high frequencies of light fluctuations as Majorana. The latter was quite aware of the temperature alterations of resistance but maintained that his effects were not entirely accounted for by this. J. E.

3252. Photoelectric Investigations of the Influence of Matter upon Very Slow Electrons. G. Lang. *Ann. d. Physik,* 16. 7. *pp.* 781–792, *April,* 1933.—Platinum films sputtered on quartz are illuminated with $\lambda = 254\ \mu\mu$ in a vacuum, and measurements are made of the influence of thickness and gas content of film upon the total photoelectric emission, absolute velocities and velocity distribution of the emitted electrons. Diminution of gas content is effected by heating, and film thicknesses from $1 \cdot 2$ to $160\ \mu\mu$ are investigated. With decreasing gas content the total emission in general passes through maxima and minima. These are well marked for thick films, but with decreasing film thickness they become less pronounced and finally disappear. In comparing velocity distributions in different cases the velocities of emission of the electrons are expressed as fractions of the corresponding maximum velocity. As the gas content of a thick film is lowered, the proportion of electrons emitted with low fractional velocities is found to decrease. This is explained by supposing that the electrons are slowed down in passing through the gas held by the film. With gas-free films the proportion of electrons with low fractional velocities is found to be greater for thin films than for thick. This is explained as due to absorption of the slower electrons by the film. L. A. W

3253. Photoelectric Effect in Insulators with Plane Polarised Light and its Dependence upon Angle of Incidence. Susanne M. Spies. *Zeits. f. Physik,* 82. 5–6. *pp.* 355–371, *May* 8, 1933.—The observations of Wehnelt and Schmerwitz upon glass [see Abstract 1172 (1930)] are confirmed experimentally and the investigations extended to mica and quartz with similar results. As the angle of incidence is increased from normal to grazing incidence, the photoelectric current with light polarised parallel to the plane of incidence passes through a maximum at the angle of polarisation and then falls off rapidly to zero. With light polarised perpendicular to the plane of incidence the photoelectric current falls off steadily from the same value at normal incidence to zero at grazing incidence. The long-wave limit of the light effective in producing an appreciable photoelectric effect with glass is estimated at about 2500 Å. L. A. W.

3254. Influence of Oxygen and Sulphur on the Photoelectric Effect of the Alkalies (K and Na). P. W. Timofeew and W. W. Nalimow. *Zeits. f. Physik,* 81. 9–10. *pp.* 687–696, *April* 7, 1933.—The maximum of the sensitivity I/I_0 of the photoelectric cell for unfiltered light from a filament lamp at a temperature 2700 Abs., where I is the current with an oxide surface and I_0 is the current with a bare surface, occurs for K and for Na at an absorption of about 40×10^{-8}gm. and 60×10^{-8}gm. of oxygen respectively per sq. cm. of surface. The increase in the sensitivity is associated with the formation of small patches of oxide film, but the effect reaches a limit due to the resistance of the film to the passage of the photoelectrons liberated from the underlying metal surface. Similar reasoning applies to sulphur and it is possible to predict the effects likely to be obtained with Se, Te and allied substances. F. C. C.

3255. Photoelectric Effect in the " Active Layer" of Carborundum Crystals. O. W. Lossew. *Phys. Zeits.* 34. *pp.* 397–403, *May* 15, 1933.—The electric conductivity at different depths in the " active layer " of carborundum single crystals [see Abstract 560 (1932)] is investigated by gradually grinding the layer away. By grinding obliquely it is found possible to explore the potential distribution in the interior at different current strengths and for currents in both directions. The results indicate that the rectifying action must be ascribed to the active layer. Current-voltage characteristics are also determined for the photoelectric effect at different stages of the grinding down of the active layer. Especially large values of the photoelectric e.m.f. at zero current (up to 3·4 volts) are observed when only about 1μ thickness of the active layer (originally 11μ thick) remains. Under these conditions the photoelectric current attains a saturation value as the applied voltage is increased. All the observations are in harmony with the supposition that in the lower regions of the active layer there is a relatively small concentration n of free electrons having a relatively large mean free path l, whereas in the crystal proper n is larger and l smaller. Evidence is adduced for the existence of similar active layers in the case of galena crystals and silicon crystals with admixtures of aluminium, copper and iron. L. A. W.

3256. Photoelectric Sensitivity of Magnesium. R. J. Cashman and W. S. Huxford. *Phys. Rev.* 43. *pp.* 811–818, *May* 15, 1933.—The photoelectric sensitivity of gas free surfaces of magnesium deposited on glass has been determined in the visible region of the spectrum. The long-wave limit for all such surfaces deposited in vacuum is approximately 5100 Å. Air or oxygen in small amounts, or nitrogen activated by a glow discharge, sensitises the surface to light of longer wave-lengths. Further oxidation of the surface causes the threshold to shift into the ultra-violet region of the spectrum. AUTHORS.

3257. Photoelectric Effect in the Blocking-Layer in Ultra-Violet Light. D. N. Nasledow and L. M. Nemenow. *Phys. Zeits. d. Sowjetunion,* 31. *pp.* 29–35, 1933. *In German.*—A plate of Cu_2O was lined with a layer of Indian ink below and a plate of pure zinc above and pressed between two pads of tinfoil, which acted as electrodes. Light from a mercury lamp was concentrated on the zinc. As a result, electrons entered the zinc in spite of the Hallwachs effect, and a current in the opposite direction was produced amounting to 10^{-9} ampere. E. E. F. d'A.

3258. Evidence for a Boundary Layer in Cuprous Oxide Rectifier (Blocking Layer) Photoelectric Cells. F. Rother and H. Bomke. *Zeits. f. Physik,* 81. 11–12. *pp.* 771–775, *April* 18, 1933.—Copper plates are heated to 1065° C. for 9 hours and cooled suddenly so that the oxide layer breaks away. Microscopic examination of the plate surface then shows it to consist of a mixture of copper and cuprous oxide. It is argued that copper must diffuse into the cuprous oxide layer in the usual preparation of rectifier photoelectric cells. At a certain depth the quantity of diffused metal must be just sufficient to reduce to cuprous oxide all the cupric oxide simultaneously formed in small quantity. Since now the conductivity of cuprous oxide is held to be due to the presence of traces of cupric oxide, this offers an explanation for the formation of a non-conducting blocking-layer of pure cuprous oxide. An analogous explanation is suggested for the blocking-layer effect at the " front " electrode. L. A. W.

3259. Blocking Layer Photoelectric Cells. M. Borissow, C. Sinelnikow and A. Walther. *Phys. Zeits. d. Sowjetunion,* 3. 2. *pp.* 146–169, 1933. *In German.*—A method is described for obtaining Cu_2O photoelectric cells with reproducible characteristics. The dependence of the photoelectric characteristics on the thickness of the electrode and on the nature of the gas in which the electrode is immersed was investigated. It is shown that the photoelectric characteristics, contrary to the theory of Frenkel and Joffé, are probably not connected with unipolar conductivity. The spectral distribution of the photo e.m.f. and its dependence on temperature are investigated. J. J. S.

3260. Effect of Frequency on the Blocking Layer Photoelectric Cell. P. Görlich. *Zeits. f. techn. Physik,* 14. 4. *pp.* 144–145, 1933.—The effect of frequency on the blocking layer photoelectric cell is investigated and the similarity to the inner photoelectric effect is noted. Trustworthy conclusions may be drawn only when monochromatic light is used. F. C. C.

3261. Functional Régime of Gasfilled Photoelectric Cells. L. Dunoyer and P. Paounoff. *Comptes Rendus,* 196. *pp.* 684–686, *March* 6, 1933.—In a previous communication attention was drawn to what has been called the " second régime " of action of certain photoelectric cells, which, under certain illuminations, exhibit the phenomenon of a sudden change in the form of the current-voltage curve as the illumination is altered. The definite existence of this " second régime " is established, and it is shown that the phenomenon cannot originate uniquely in ionisation phenomenon occurring in the gas filling. A possible mechanism of the effect is discussed, and it is suggested that the phenomenon is associated with the form of cell used, the arrangement of the electrodes and of the insulating surfaces. J. S. G. T.

3262. Selenium Rectifier Photoelectric Cells. L. Bergmann. *Phys. Zeits.* 34. *pp.* 227–228, *March* 15, 1933.—Describes a miniature d.c. motor made of a rectifier selenium cell divided into three sectors and a d.c. meter. When any sector is illuminated, a current traverses a flat coil between the pole-pieces of the permanent magnet and an appropriate rotation is produced. As one sector after another is brought into play and is illuminated the movement becomes continuous. The speed varies as the illumination. By suitable glass screens its curve of sensitiveness is made equal to that of the eye. The whole is arranged as a pocket photometer, or luxmeter, to measure from 1 to 20,000 lux in three stages of sensitiveness. Instead of a continuous rotation the deflection of a pointer galvanometer is preferable. The sensitive surface is about 20 cm.^{2}, but the effect is not proportional to the surface. E. E. F. d'A.

3263. Photoelectric Conductivity and Absorption of Lenard Phosphors. L. Weber. *Ann. d. Physik,* 16. 7. *pp.* 821–843, *April,* 1933.—It is known that the electrical conductivity of Lenard phosphors increases when ultra-violet radiation falls upon them. The author had made a careful investigation of the phenomenon with particular reference to the effect of the red and infra-red end of the spectrum. The effect of temperature upon the normal conductivity is also investigated. It is shown that the conductivity is most affected by certain wave-lengths and this is correlated with the absorption of the material. The increase of conductivity is ascribed to the normal photoelectric effect. J. E. R. C.

3264. Internal Photoelectric Effect in Liquid Dielectrics. G. Liandrat. *Comptes Rendus,* 196. *pp.* 1385–1386, *May* 8, 1933.—The conductivity of the carbon tetrachloride used rose from 10^{-15} to 10^{-14} mho on exposure for one hour to a mercury arc and returned to its initial value in 2 hours after removal. But the initial conductivity was so high and the conductivities subsequently observed so irregular that no inference as to its photo-conductivity could safely be drawn ; for this CCl_4 of initial conductivity $<10^{-17}$ mho is necessary. C. A. S.

See also Abstracts 2745, 2938, 2952, 2975, 2980, 2981, 3162, 3196.

PIEZOELECTRICITY.

3265. Piezoelectric Properties of Tourmaline. W. Fox and M. Underwood. *Physics,* 4. *pp.* 10–13, *Jan.,* 1933.—Oscillating piezoelectric plates of different frequencies have been made from California and South African tourmaline. These plates have a frequency response of approximately 3770 kc. per mm. of thickness. The temperature coefficient for both specimens was found to be negative and is about 35·5 parts per million per ° C. for the African specimen and 38·1 parts per million per ° C. for the California crystal. Comparison of the tourmaline plates with a Y-cut quartz plate of the same size and frequency shows the tourmaline oscillators decidedly inferior on the basis of power output. AUTHORS.

3266. Converse Piezoelectric Effect in Mixed Crystals Isomorphous with Rochelle Salt. S. Bloomenthal. *Physics,* 4. *pp.* 172–177, *May,* 1933.—The temperature dependence of the piezoelectric strain constant d_{14} was investigated in mixed crystals isomorphous with Rochelle salt. Crystals oriented for utilisation of Voigt's theory of the converse piezoelectric effect in the hemihedral class of the orthorhombic system were grown at constant temperature from supersaturated solutions of Rochelle salt containing isomorphous impurities $C_4H_4O_6NaNH_4 \cdot 4H_2O$ or $C_4H_4O_6Na\,Tl \cdot 4H_2O$ and measurements of the strain resulting from an applied electric field were made in the range 10 to 35° C. Hysteresis and saturation occur in the range of large piezoelectric activity where d_{14} evaluated from the straight portion of the strain curve is approximately 5×10^{-4} in both the pure salt and mixed crystal, a value several times as large as that reported from measurements of the direct effect in Rochelle salt. The critical temperature for a mixed crystal lies below that of pure Rochelle salt ($25 \times 273°$ K) and the shift observed compares favourably in magnitude with the value calculated from the dipole theory of dielectrics. The region in which d_{14} decreases to about 10^{-5} covers 3° C. The value of d_{14} diminishes further as the temperature is raised. d_{14} is defined as twice the change in length per cm. length of a narrow crystal cut at

45° with the *Y* and *Z* axes when unit electrostatic field is applied in the *X* direction. AUTHOR.

3267. Electric Properties of Isomorphous Crystals. M. Eremejew and B. Kurtschatow. *Phys. Zeits. d. Sowjetunion*, 3. 3. *pp.* 304–320, 1933.—An investigation was made of the dielectric properties of crystal mixtures of (*a*) $NaKC_4H_4O_6.4H_2O$ and (*b*) $NaNH_4C_4H_4O_6.4H_2O$ with different proportions of the two components. The mixtures investigated can be divided into three groups. In the first group increase of the content of the $NaNH_4$ salt gives rise to a general reduction of the piezoelectric properties of the crystal. With proportions of (*a*) and (*b*) of 100 to 12·5 the piezoelectric property had a minimum value. The second group, with large proportions of (*b*), is characterised by the development of all the anomalous electrical properties of Rochelle salt. The third group comprises mixtures with 15 to 20 % of (*b*). Hysteresis laws for the second group were investigated, also temperature variation of the piezoelectric effect. Hysteresis effects at temperatures below the Curie point were also investigated. A. W.

See also Abstracts 2768, 2958.

THERMIONICS.

3268. Variation of Secondary Emission with Heat Treatment. P. L. Copeland. *Frank. Inst., J.* 215. *pp.* 435–443, *April*, 1933.—The ratio of the number of electrons striking a surface to the number leaving it was determined under various conditions for a number of metals contaminated by the condensation of grease vapours on them. The curves showing the variation of secondary emission with incident electron energy (evidently characteristic of the contamination rather than of the metals) are similar for all the targets and resemble the results obtained by Gehrts. Reducing the amount of the contamination by heating the metals at first reduces the secondary emission until it falls below that expected from a clean metal. The emission then increases with further heating and the characteristics of the metal appear. The variation of the work function during the "outgassing" process is indicated by this increase of the secondary emission followed by a decrease of the secondary emission as the process continues. AUTHOR.

3269. Secondary Emission of Electrons from Molybdenum. P. L. Copeland. *Frank. Inst., J.* 215. *pp.* 593–598, *May*, 1933.—The ratio of the number of secondary electrons to primary electrons of various energies incident on a molybdenum plate (previously subjected to severe heat treatment) was measured. The results obtained resemble those reported by Petry more closely than they do the more recent work of Hyatt and Smith. [See Abstract 1280 (1929).] Possibilities for explaining discrepancies are suggested. AUTHOR.

3270. Heat of Evaporation of Electrons. T. Franzini. *N. Cimento*, 10. *pp.* 57–77, *Feb.*, 1933.—Study of the cooling of a tungsten filament due to thermionic emission. For filament-temperatures up to 2150° K., the energy E lost, expressed as a function of the thermionic current j, is in harmony with the hypothesis that there is a Maxwellian distribution of the initial velocities of the emitted electrons. For higher temperatures E increases very rapidly in such a way as to indicate that the current from the wire is not wholly of thermionic origin, but is in part due to electrons of higher velocities caught up from the applied external field. A. D.